STELLA MARYS COLLEGE OF ENGINEERING

[An Autonomous Institution | Approved by AICTE, New Delhi | Affiliated to Anna University, Chennai | Accredited by NAAC | Accredited by NBA (MECH & CSE)]

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REGULATION – 2024

CURRICULUM AND SYLLABUS

B.E – MECHANICAL ENGINEERING

(Outcome Based Education, Activity Based Learning & Choice Based Credit System)

Institution Vision and Mission

VISION:

To be a beacon of academic excellence, empowering future innovators with technical mastery to harness technology for positive global change.

MISSION:

- To Cultivate a vibrant learning environment where students delve into the frontiers of technical knowledge, hone their problem-solving skills, and embrace innovation to transform ideas into solutions that address global challenges.

- To bridge the gap between technical brilliance and real-world impact by forging strong industry partnerships, fostering cutting-edge research, and nurturing entrepreneurial drive in our students, empowering them to build a better future through technology.

- To ignite the spark of intellectual curiosity within every student, equip them with the tools and knowledge to become pioneers in their chosen fields, and guide them towards ethical and responsible use of technology for the betterment of humanity.

Department Vision and Mission

VISION:

To excel in mechanical engineering by producing skilled, innovative engineers who address societal challenges and develop impactful solutions through research, collaboration, and practical applications.

MISSION:

- To equip students with the knowledge and skills necessary to become exceptional mechanical engineers, capable of solving complex problems and driving positive change through innovation and ethical leadership.

- To conduct innovative research, develop advanced technologies, and collaborate with industry partners to address critical engineering challenges and build a sustainable future.

- To apply engineering knowledge to enhance communities, inspire future generations, and protect the environment through safe and responsible practices.

REGULATIONS 2024
CHOICE BASED CREDIT SYSTEM

B. E. MECHANICAL ENGINEERING

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

I. Effectuating success in careers by exploring with the design, digital and computational analysis of engineering systems, experimentation and testing, smart manufacturing, technical services, and research.
II. Amalgamating effectively with stakeholders to update and improve their core competencies and abilities to ethically compete in the ever-changing multicultural global enterprise.
III. To encourage multi-disciplinary research and development to foster advanced technology, and to nurture innovation and entrepreneurship in order to compete successfully in the global economy.
IV. To globally share and apply technical knowledge to create new opportunities that proactively advances our society through team efforts and to solve various challenging technical, environmental and societal problems.
V. To create world class mechanical engineers capable of practice engineering ethically with a solid vision to become great leaders in academia, industries and society.

PROGRAM OUTCOMES (POs)

PO	GRADUATE ATTRIBUTE
1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
2	**Problem analysis**: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineeringactivities with an understanding of the limitations.
6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7	**Environment and sustainability**: Understand the impact of the professional engineering

solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8 **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9 **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10 **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11 **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12 **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

On successful completion of the Mechanical Engineering Degree programme, theGraduates shall exhibit the following:

1. Apply the knowledge gained in Mechanical Engineering for design and developmentand manufacture of engineering systems.
2. Apply the knowledge acquired to investigate research-oriented problems in mechanical engineering with due consideration for environmental and social impacts.
3. Use the engineering analysis and data management tools for effective management of multidisciplinary projects.

PEO / PO MAPPING:

PEOs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
I.	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
II.	3	2	2	2	2	1	1	1	3		2	1	2	3	3
III.	3	1	2	1	2	2	1		1	2		3	3	2	2
IV.	2	2	2	2	2		2				1	2	2	3	3
V.	3	2	2	2	1	3	2	2	2	1	1	3	3	2	2

SEMESTER I								
Sl. No	**Course Code**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
1	24IP3151	Induction Program	-	-	0	0	0	0
Theory Courses								
2	24HS3152	Professional English - I	HSMC	3	3	0	0	3
3	24MA3151	Matrices and Calculus	BSC	4	3	1	0	4
4	24PH3151	Engineering Physics	BSC	3	3	0	0	3
5	24CY3151	Engineering Chemistry	BSC	3	3	0	0	3
6	24GE3151	Problem Solving and Python Programming	ESC	3	3	0	0	3
7	24GE3152	தமிழர் மரபு / Heritage of Tamils	HSMC	1	1	0	0	1
Laboratory Course								
8	24GE3171	Problem Solving and Python Programming Laboratory	ESC	4	0	0	4	2
9	24BS3171	Physics and Chemistry Laboratory	BSC	4	0	0	4	2
10	24GE3172	English Laboratory	EEC	2	0	0	2	1
Employability Enhancement Course								
11	24TP3101	Skill Enhancement - I	EEC	2	0	0	2	0
		TOTAL		29	16	1	12	22

SEMESTER II								
Sl. No	**Course Code**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
Theory Courses								
1	24HS3252	Professional English - II	HSMC	2	2	0	0	2
2	24MA3251	Statistics and Numerical Methods	BSC	4	3	1	0	4
3	24PH3251	Materials Science	BSC	3	3	0	0	3
4	24BE3251	Basic Electrical and Electronics Engineering	ESC	3	3	0	0	3
5	24GE3251	Engineering Graphics	ESC	6	2	0	4	4
6	24GE3252	தமிழரும் தொழில் நுட்பமும் / Tamils and Technology	HSMC	1	1	0	0	1
		NCC Credit Course Level 1#		2	2	0	0	2
Laboratory Course								
6	24GE3271	Engineering Practices Laboratory	ESC	4	0	0	4	2
7	24BE3271	Basic Electrical and Electronics Engineering Laboratory	ESC	4	0	0	4	2
8	24GE3272	Communication Laboratory / Foreign Language $	EEC	4	0	0	4	2
Employability Enhancement Course								
9	24TP3201	Skill Enhancement – II	EEC	2	0	0	2	0
		TOTAL		35	16	1	18	23

[#] NCC Credit Course level 1 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

[$] Skill Based Course

SEMESTER III								
Sl. No	**Course Code**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
Theory Courses								
1	24MA3352	Partial Differential Equations and Complex Functions	HSMC	4	3	1	0	4
2	24ME3351	Engineering Mechanics	PCC	3	3	0	0	3
3	24ME3352	Engineering Thermodynamics	PCC	3	3	0	0	3
4	24ME3353	Manufacturing Technology – I	PCC	3	3	0	0	3
5	24ME3354	Engineering Materials and Metallurgy	PCC	3	3	0	0	3
Theory Courses with Laboratory Component								
6	24ME3355	Fluid Mechanics and Machinery	PCC	5	3	0	2	4
Laboratory Course								
7	24ME3311	Manufacturing Technology Laboratory - I	PCC	4	0	0	4	2
8	24ME3312	Computer Aided Machine Drawing Laboratory	PCC	4	0	0	4	2
Employability Enhancement Courses								
9	24TP3301	Skill Enhancement – III	EEC	2	0	0	2	1
		TOTAL		31	18	1	12	25

SEMESTER IV								
Sl. No	**Course Code**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
Theory Courses								
1	24ME3451	Thermal Engineering	PCC	4	3	1	0	4
2	24ME3452	Fluid Power Automation	PCC	3	3	0	0	3
3	24ME3453	Manufacturing Technology - II	PCC	3	3	0	0	3
4	24ME3454	Product Design and Development	PCC	3	3	0	0	3
Theory Courses with Laboratory Component								
5	24ME3455	Kinematics and Dynamics of Machinery	PCC	5	3	0	2	4
6	24ME3456	Mechanics of Materials	PCC	5	3	0	2	4
Laboratory Course								
7	24ME3411	Thermal Engineering Laboratory	PCC	4	0	0	4	2
8	24ME3412	Manufacturing Technology Laboratory – II	PCC	4	0	0	4	2
Employability Enhancement Courses								
9	24TP3401	Skill Enhancement – IV	EEC	2	0	0	2	1
TOTAL				33	18	1	14	26

SEMESTER V								
Sl. No	**Course Code**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
Theory Courses								
1	24ME3551	Design of Machine Elements	PCC	3	3	0	0	3
2	24IC3401	Engineering Entrepreneurship Development	ICC	4	2	0	2	3
3		Professional Elective Course – I	PEC					3
4		Professional Elective Course – II	PEC					3
Theory Courses with Laboratory Component								
5	24ME3552	Heat and Mass Transfer	PCC	5	3	0	2	4
6	24ME3553	Metrology and Measurements	PCC	4	2	0	2	3
Laboratory Course								
7	24ME3511	CAD / CAM Laboratory	PCC	4	0	0	4	2
Employability Enhancement Courses								
8	24TP3501	Skill Enhancement – V	EEC	2	0	0	2	1
9	24ME3513	Summer Internship[#]	EEC	0	0	0	0	1
Mandatory Course								
10		Mandatory Course - I	MC	3	3	0	0	0
TOTAL								23

[#]Two weeks Summer Internship carries one credit and it will be done during IV semester summer vacation and same will be evaluated in V semester & Mandatory Course - I is a Non-credit Course.

SEMESTER VI								
Sl. No	**Course Code**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
Theory Courses								
1	24HS3001	Universal Human Values	HSMC	2	2	0	0	2
2	24ME3651	Design of Transmission Systems	PCC	3	3	0	0	3
3		Professional Elective Course – III	PEC					3
4		Professional Elective Course – IV	PEC					3
5		Open Elective – I**	OEC					3
Theory Course with Laboratory Component								
6	24ME3652	Finite Element Analysis	PCC	5	3	0	2	4
Laboratory Course								
7	24ME3611	Automotive Engineering Laboratory	PCC	4	0	0	4	2
Employability Enhancement Courses								
8	24ME3612	Design and Fabrication Project	EEC	4	0	0	4	2
9	24TP3601	Skill Enhancement – VI	EEC	2	0	0	2	1
Mandatory Course								
10		Mandatory Course - II	MC	3	3	0	0	0
TOTAL								23

*****Open Elective I to III (Shall be chosen from the list of open electives offered by other Programmes)***
Mandatory Course-II is a Non-credit Course.

SEMESTER VII								
Sl. No	**Course Code**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
Theory Courses								
1	24ME3751	Computer Integrated Manufacturing	PCC	3	3	0	0	3
2		Professional Elective Course – V	PEC					3
3		Professional Elective Course – VI	PEC					3
4		Open Elective – II**	OEC					3
5		Open Elective – III**	OEC					3
Theory Course with Laboratory Component								
6	24ME3752	Mechatronics and IoT	PCC	4	2	0	2	3
Employability Enhancement Courses								
7	24ME3711	Summer Internship[#]	EEC	0	0	0	0	1
8	24TP3701	Skill Enhancement – VII	EEC	2	0	0	2	1
TOTAL								20

[#]***Two weeks Summer Internship carries one credit and it will be done during VI semester summer vacation and same will be evaluated in VII semester.***

*****Open Elective I to III (Shall be chosen from the list of open electives offered by other Programmes).***

SEMESTER VIII								
Sl. No	**Course Code**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
Employability Enhancement Course								
1	24ME3811	Project Work / Internship	EEC	16	0	0	16	8
TOTAL				16	0	0	16	8

TOTAL: 170 CREDITS

MANDATORY COURSES – I*

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	24MX3081	Introduction to Women and Gender Studies	MC	3	3	0	0	0
2	24MX3082	Indian knowledge systems	MC	3	3	0	0	0
3	24MX3083	Production and Operations Management for Entrepreneurs	MC	3	3	0	0	0
4	24MX3084	Disaster Risk Reduction and Management	MC	3	3	0	0	0
5	24MX3085	Well - being with traditional practices- yoga, ayurveda and siddha	MC	3	3	0	0	0

Mandatory Courses are offered as Non-Credit courses.

MANDATORY COURSES – II*

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	24MX3086	Environmental Sciences and Sustainability	MC	3	3	0	0	0
2	24MX3087	History of Science and Technology in India	MC	3	3	0	0	0
3	24MX3088	Political and Economic Thought for a Humane Society	MC	3	3	0	0	0
4	24MX3089	State, Nation Building and Politics in India	MC	3	3	0	0	0
5	24MX3090	Industrial Safety	MC	3	3	0	0	0

Mandatory Courses are offered as Non-Credit courses.

PROFESSIONAL ELECTIVE COURSES: VERTICALS*

Vertical 1	Vertical 2	Vertical 3	Vertical 4	Vertical 5	Vertical 6	Vertical 7
Thermal Engineering	**Manufacturing Engineering**	**Engineering Design**	**Materials Engineering**	**Sustainable Energy Engineering**	**Industrial Engineering**	**Safety Engineering**
Fuels and Combustion	Welding Engineering	Computer Aided Design and Prototyping	Materials Characterization	Renewable Energy Technologies	Industrial Management	Basics of Safety Engineering
Turbo Machines	Additive Manufacturing	Design for X	Mechanical Behaviour of Materials	Hydrogen and Fuel Cell Technologies	Production Planning and Control	Occupational Health and Hygiene
Energy Generation Technologies	Lean Manufacturing	Design Concepts in Engineering	Composite Materials	Bioenergy Conversion Technologies	Process Planning and Cost Estimation	Fire Engineering and Protection
Engine and Vehicle Technology	Advanced Machining Processes	Tool Design	Fundamentals of Nanomaterials	Energy Storage Technologies	Quality Engineering	Safety in Construction, Erection & Maintenance
Advanced Internal Combustion Engineering	Digital Manufacturing	Tribological Design	Powder Metallurgy	Energy Efficient Buildings	Product Life Cycle Management	Transportation Systems and Safety
Refrigeration and Air Conditioning	Industrial Robotics	Mechanical Vibrations	Materials for Electronics	Energy Conservation and Management	Engineering Economics	Safety in Engineering Industry
Gas Dynamics and Jet Propulsion	MEMS	Design Codes and Standards	Advanced Rare Earth Materials	Carbon Footprint Estimation and Reduction Techniques	Operational Research	Safety in Petroleum and Petrochemical Industries
Computational Fluid Dynamics	Nano Technology and Surface Engineering	Ergonomics in Design	Corrosion Science and Engineering	Solar Energy Applications	Reverse Engineering	Fire Fighting and Safety Equipment

*Refer to the Regulations 2024, Clause 6.2 for the selection of the Professional Elective Courses.

PROFESSIONAL ELECTIVE COURSES

VERTICAL 1: THERMAL ENGINEERING

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	24ME3011	Fuels and Combustion	PEC	3	3	0	0	3
2	24ME3012	Turbo Machines	PEC	3	3	0	0	3
3	24ME3013	Energy Generation Technologies	PEC	3	3	0	0	3
4	24ME3014	Engine and Vehicle Technology	PEC	3	3	0	0	3
5	24ME3015	Advanced Internal Combustion Engineering	PEC	3	3	0	0	3
6	24ME3016	Refrigeration and Air Conditioning	PEC	3	3	0	0	3
7	24ME3017	Gas Dynamics and Jet Propulsion	PEC	3	3	0	0	3
8	24ME3018	Computational Fluid Dynamics	PEC	3	3	0	0	3

VERTICAL 2: ADVANCED MANUFACTURING ENGINEERING

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	24ME3021	Welding Engineering	PEC	3	3	0	0	3
2	24ME3022	Additive Manufacturing	PEC	3	3	0	0	3
3	24ME3023	Lean Manufacturing	PEC	3	3	0	0	3
4	24ME3024	Advanced Machining Processes	PEC	3	3	0	0	3
5	24ME3025	Digital Manufacturing	PEC	3	3	0	0	3
6	24ME3026	Industrial Robotics	PEC	3	3	0	0	3
7	24ME3027	MEMS	PEC	3	3	0	0	3
7	24ME3028	Nano Technology and Surface Engineering	PEC	3	3	0	0	3

VERTICAL 3: DESIGN ENGINEERING

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	24ME3031	Computer Aided Design and Prototyping	PEC	3	3	0	0	3
2	24ME3032	Design for X	PEC	3	3	0	0	3
3	24ME3033	Design Concepts in Engineering	PEC	3	3	0	0	3
4	24ME3034	Tool Design	PEC	3	3	0	0	3
5	24ME3035	Tribological Design	PEC	3	3	0	0	3
6	24ME3036	Mechanical Vibrations	PEC	3	3	0	0	3
7	24ME3037	Design Codes and Standards	PEC	3	3	0	0	3
8	24ME3038	Ergonomics in Design	PEC	3	3	0	0	3

VERTICAL 4: MATERIALS ENGINEERING

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	24ME3041	Materials Characterization	PEC	3	3	0	0	3
2	24ME3042	Mechanical Behaviour of Materials	PEC	3	3	0	0	3
3	24ME3043	Composite Materials	PEC	3	3	0	0	3
4	24ME3044	Fundamentals of Nanomaterials	PEC	3	3	0	0	3
5	24ME3045	Powder Metallurgy	PEC	3	3	0	0	3
6	24ME3046	Materials for Electronics	PEC	3	3	0	0	3
7	24ME3047	Advanced Rare Earth Materials	PEC	3	3	0	0	3
8	24ME3048	Corrosion Science and Engineering	PEC	3	3	0	0	3

VERTICAL 5: SUSTAINABLE ENERGY ENGINEERING

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	24ME3051	Renewable Energy Technologies	PEC	3	3	0	0	3
2	24ME3052	Hydrogen and Fuel Cell Technologies	PEC	3	3	0	0	3
3	24ME3053	Bioenergy Conversion Technologies	PEC	3	3	0	0	3
4	24ME3054	Energy Storage Technologies	PEC	3	3	0	0	3
5	24ME3055	Energy Efficient Buildings	PEC	3	3	0	0	3
6	24ME3056	Energy Conservation and Management	PEC	3	3	0	0	3
7	24ME3057	Carbon Footprint Estimation and Reduction Techniques	PEC	3	3	0	0	3
8	24ME3058	Solar Energy Applications	PEC	3	3	0	0	3

VERTICAL 6: INDUSTRIAL ENGINEERING

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	24ME3061	Industrial Management	PEC	3	3	0	0	3
2	24ME3062	Production Planning and Control	PEC	3	3	0	0	3
3	24ME3063	Process Planning and Cost Estimation	PEC	3	3	0	0	3
4	24ME3064	Quality Engineering	PEC	3	3	0	0	3
5	24ME3065	Product Life Cycle Management	PEC	3	3	0	0	3
6	24ME3066	Engineering Economics	PEC	3	3	0	0	3
7	24ME3067	Operational Research	PEC	3	3	0	0	3
8	24ME3068	Reverse Engineering	PEC	3	3	0	0	3

VERTICAL 7: SAFETY ENGINEERING

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	24ME3071	Basics of Safety Engineering	PEC	3	3	0	0	3
2	24ME3072	Occupational Health and Hygiene	PEC	3	3	0	0	3
3	24ME3073	Fire Engineering and Protection	PEC	3	3	0	0	3
4	24ME3074	Safety In Construction Erection Maintenance	PEC	3	3	0	0	3
5	24ME3075	Transportation Systems and Safety	PEC	3	3	0	0	3
6	24ME3076	Safety In Engineering Industry	PEC	3	3	0	0	3
7	24ME3077	Safety In Petroleum and Petrochemical Industries	PEC	3	3	0	0	3
8	24ME3078	Fire Fighting and Safety Equipment	PEC	3	3	0	0	3

OPEN ELECTIVES

OPEN ELECTIVE I

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	24OEME01	Fundamentals of Aeronautical Engineering	OEC	3	3	0	0	3
2	24OEME02	Energy Technology	OEC	3	3	0	0	3

OPEN ELECTIVE II

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	24OEME03	Environmental Engineering and Pollution Control	OEC	3	3	0	0	3
2	24OEME04	Elements of Marine Engineering	OEC	3	3	0	0	3

OPEN ELECTIVE III

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	24OEME05	Alternative Fuels and Energy Systems	OEC	3	3	0	0	3
2	24OEME06	Foundation of Robotics	OEC	3	3	0	0	3

**** Students shall choose the open elective courses, such that the course contents are not similar to any other course contents / title under other course categories.***

***** Students are not permitted to option for Open Elective Courses (OEC) offered by their parent department.***

SUMMARY OF CREDITS

Semester	PCC	PEC	ESC	BSC	HSMC	OEC	EEC	ICC	Total
I	-	-	5	12	4	-	1	-	22
II	-	-	11	7	3	-	2	-	23
III	20	-	-	-	4	-	1	-	25
IV	25	-	-	-	-	-	1	-	26
V	12	6	-	-	-	-	2	3	23
VI	9	6	-	-	2	3	3	-	23
VII	6	6	-	-	-	6	2	-	20
VIII	-	-	-	-	-	-	8	-	8
Total	**72**	**18**	**16**	**19**	**13**	**9**	**20**	**3**	**170**
% of Category	**42**	**11**	**9**	**11**	**8**	**5**	**12**	**2**	**100**

CATEGORY OF COURSES

BSC – Basic Science Course

ESC – Engineering Science Course

HSMC – Humanities and Social Sciences including Management Course

PCC – Professional Core Course

PEC – Professional Elective Course

OEC – Open Elective Course

ICC – Institutional Credit Course

EEC – Employability Enhancement Course

MC – Mandatory Course

24IP3151 **INDUCTION PROGRAMME**

This is a mandatory 2-week programme to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over.

The induction programme has been introduced by AICTE with the following objective:

“Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond. The graduating student must have knowledge and skills in the area of his/her study. However, he/she must also have broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he/she would understand and fulfill his/her responsibility as an engineer, a citizen and a human being. Besides the above, several meta-skills and underlying values are needed.”

“One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character. “

Hence, the purpose of this programme is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.

The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

(i) Physical Activity

This would involve a daily routine of physical activity with games and sports, yoga, gardening, etc.

(ii) Creative Arts

Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it every day for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, grow into engineering design later.

(iii) Universal Human Values

This is the anchoring activity of the Induction Programme. It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting stay in the hostel and department, be sensitive to others, etc. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through do's and don’ts, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real-life activities rather than lecturing.
Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It would be effective that the faculty mentor assigned is also the faculty advisor for the student for the full duration of the UG programme.

(iv) Literary Activity

Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

(v) Proficiency Modules

This would address some lacunas that students might have, for example, English, computer familiarity etc.

(vi) Lectures by Eminent People

Motivational lectures by eminent people from all walks of life should be arranged to give the students exposure to people who are socially active or in public life.

(vii) Visits to Local Area

A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the under privileged.

(viii) Familiarization to Dept./Branch & Innovations

They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

(ix) Department Specific Activities

About a week can be spent in introducing activities (games, quizzes, social interactions, small experiments, design thinking etc.) that are relevant to the particular branch of Engineering /Technology/Architecture that can serve as a motivation and kindle interest in building things (become a maker) in that particular field. This can be conducted in the form of a workshop. For example, CSE and IT students may be introduced to activities that kindle computational thinking, and get them to build simple games. ECE students may be introduced to building simple circuits as an extension of their knowledge in Science, and so on. Students may be asked to build stuff using their knowledge of science.

Induction Programme is totally an activity-based programme and therefore there shall be notests / assessments during this programme.

References:
Guide to Induction program from AICTE

24HS3152 **PROFESSIONAL ENGLISH - I** **L T P C**
3 0 0 3

OBJECTIVES:

- To improve the communicative competence of learners
- To learn to use basic grammatic structures in suitable contexts
- To acquire lexical competence and use them appropriately in a sentence and understand their meaning in a text
- To help learners use language effectively in professional contexts
- To develop learners' ability to read and write complex texts, summaries, articles, blogs, definitions, essays and user manuals.

UNIT I INTRODUCTION TO EFFECTIVE COMMUNICATION 1

What is effective communication? (Explain using activities) Why is communication critical for excellence during study, research and work? What are the seven C's of effective communication? What are key language skills? What is effective listening? What does it involve? What is effective speaking? What does it mean to be an excellent reader? What should you be able to do? What is effective writing? How does one develop language and communication skills? What does the course focus on? How are communication and language skills going to be enhanced during this course? What do you as a learner need to do to enhance your English language and communication skills to get the best out of this course?

INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION 8

Reading - Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts and emails. Writing - Writing emails / letters introducing oneself. Grammar - Present Tense (simple and progressive); Question types: Why/ Yes or No/ and Tags. Vocabulary - Synonyms; One word substitution; Abbreviations & Acronyms (as used in technical contexts).

UNIT II NARRATION AND SUMMATION 9

Reading - Reading biographies, travelogues, newspaper reports, Excerpts from literature, and travel & technical blogs. Writing - Guided writing-- Paragraph writing Short Report on an event (field trip etc.) Grammar –Past tense (simple); Subject-Verb Agreement; and Prepositions. Vocabulary - Word forms (prefixes& suffixes); Synonyms and Antonyms. Phrasal verbs.

UNIT III DESCRIPTION OF A PROCESS / PRODUCT 9

Reading – Reading advertisements, gadget reviews; user manuals. Writing - Writing definitions; instructions; and Product /Process description. Grammar - Imperatives; Adjectives; Degrees of comparison; Present & Past Perfect Tenses. Vocabulary - Compound Nouns, Homonyms; and Homophones, discourse markers (connectives & sequence words).

UNIT IV CLASSIFICATION AND RECOMMENDATIONS 9

Reading – Newspaper articles; Journal reports –and Non-Verbal Communication (tables, pie charts etc,). Writing – Note-making / Note-taking (*Study skills to be taught, not tested); Writing recommendations; Transferring information from non-verbal (chart, graph etc, to verbal mode) Grammar – Articles; Pronouns - Possessive & Relative pronouns. Vocabulary - Collocations; Fixed / Semi fixed expressions.

UNIT V EXPRESSION 9

Reading – Reading editorials; and Opinion Blogs; Writing – Essay Writing (Descriptive or narrative). Grammar – Future Tenses, Punctuation; Negation (Statements & Questions); and Simple, Compound & Complex Sentences. Vocabulary - Cause & Effect Expressions – Content vs Function words.

TOTAL: 45 PERIODS

LEARNING OUTCOMES:

At the end of the course, learners will be able

- To use appropriate words in a professional context
- To gain understanding of basic grammatical structures and use them in right context.
- To read and infer the denotative and connotative meanings of technical texts
- To read and interpret information presented in tables, charts and other graphic forms
- To write definitions, descriptions, narrations and essays on various topics

TEXT BOOKS:

1. English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, (2020 edition)
2. English for Science & Technology Cambridge University Press, 2021. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.

REFERENCE BOOKS:

1. Technical Communication – Principles and Practices by Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.
2. A Course Book on Technical English by Lakshminarayanan, Scitech Publications (India) Pvt. Ltd.
3. English For Technical Communication (With CD) By Aysha Viswamohan, Mcgraw HillEducation, ISBN : 0070264244.
4. Effective Communication Skill, Kulbhusan Kumar, RS Salaria, Khanna Publishing House.
5. Learning to Communicate – Dr. V. Chellammal, Allied Publishing House, New Delhi,2003.

ASSESSMENT PATTERN

Two internal assessments and an end semester examination to test students' reading and writing skills along with their grammatical and lexical competence.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	1	1	1	1	3	3	3	1	3	-	3	-	-	-
2	1	1	1	1	1	3	3	3	1	3	-	3	-	-	-
3	2	3	2	3	2	3	3	3	2	3	3	3	-	-	-
4	2	3	2	3	2	3	3	3	2	3	3	3	-	-	-
5	2	3	3	3	-	3	3	3	2	3	-	3	-	-	-
Avg.	**1.6**	**2.2**	**1.8**	**2.2**	**1.5**	**3**	**3**	**3**	**1.6**	**3**	**3**	**3**	**-**	**-**	**-**

- 1-low, 2-medium, 3-high, '-"- no correlation
- **Note:** The average value of this course to be used for program articulation matrix.

24MA3151 MATRICES AND CALCULUS

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To familiarize the students with differential calculus.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To make the students understand various techniques of integration.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and

their applications.

UNIT - I MATRICES 9 + 3

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley - Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms – Applications: Stretching of an elastic membrane.

UNIT - II DIFFERENTIAL CALCULUS 9 + 3

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules (sum, product, quotient, chain rules) - Implicit differentiation - Logarithmic differentiation - Applications: Maxima and Minima of functions of one variable.

UNIT - III FUNCTIONS OF SEVERAL VARIABLES 9 + 3

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Applications: Maxima and minima of functions of two variables and Lagrange's method of undetermined multipliers.

UNIT - IV INTEGRAL CALCULUS 9 + 3

Definite and Indefinite integrals - Substitution rule - Techniques of Integration: Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals - Applications: Hydrostatic force and pressure, moments and centres of mass.

UNIT - V MULTIPLE INTEGRALS 9 + 3

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals – Applications: Moments and centres of mass, moment of inertia.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

- Use the matrix algebra methods for solving practical problems.
- Apply differential calculus tools in solving various application problems.
- Able to use differential calculus ideas on several variable functions.
- Apply different methods of integration in solving practical problems.
- Apply multiple integral ideas in solving areas, volumes and other practical problems.

TEXT BOOKS:

1. Kreyszig.E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
2. Grewal.B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2018.
3. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 8th Edition, New Delhi, 2015. [For Units II & IV - Sections 1.1, 2.2, 2.3, 2.5, 2.7 (Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1 (Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 - 7.4 and 7.8].

REFERENCES:

1. Anton. H, Bivens. I and Davis. S, " Calculus ", Wiley, 10th Edition, 2016.
2. Bali. N., Goyal. M. and Watkins. C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
3. Jain. R.K. and Iyengar. S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 5th Edition, 2016.
4. Narayanan. S. and Manicavachagom Pillai. T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.
5. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd,

New Delhi, 2016.
6. Srimantha Pal and Bhunia. S.C, "Engineering Mathematics" Oxford University Press, 2015.
7. Thomas. G. B., Hass. J, and Weir. M.D, "Thomas Calculus ", 14th Edition, Pearson India, 2018.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
2	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
3	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
4	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
5	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
Avg.	**3**	**3**	**1**	**1**	**0**	**0**	**0**	**0**	**2**	**0**	**2**	**3**	**-**	**-**	**-**

- 1-low, 2-medium, 3-high, '-"- no correlation
- **Note:** The average value of this course to be used for program articulation matrix.

24PH3151 ENGINEERING PHYSICS L T P C
3 0 0 3

COURSE OBJECTIVES

- To make the students effectively to achieve an understanding of mechanics.
- To enable the students to gain knowledge of electromagnetic waves and its applications.
- To introduce the basics of oscillations, optics and lasers.
- Equipping the students to be successfully understand the importance of quantum physics.
- To motivate the students towards the applications of quantum mechanics.

UNIT I MECHANICS 9

Multi-particle dynamics: Center of mass (CM) – CM of continuous bodies – motion of the CM – kinetic energy of system of particles. Rotation of rigid bodies: Rotational kinematics – rotational kinetic energy and moment of inertia - theorems of M .I –moment of inertia of continuous bodies – M.I of a diatomic molecule - torque – rotational dynamics of rigid bodies – conservation of angular momentum – rotational energy state of a rigid diatomic molecule - gyroscope - torsional pendulum – double pendulum –Introduction to nonlinear oscillations.

UNIT II ELECTROMAGNETIC WAVES 9

The Maxwell's equations - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure - Cell-phone reception. Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interface for normal incidence.

UNIT III OSCILLATIONS, OPTICS AND LASERS 9

Simple harmonic motion - resonance –analogy between electrical and mechanical oscillating systems - waves on a string - standing waves - traveling waves - Energy transfer of a wave - sound waves - Doppler effect. Reflection and refraction of light waves - total internal reflection - interference –Michelson interferometer –Theory of air wedge and experiment. Theory of laser - characteristics - Spontaneous and stimulated emission - Einstein's coefficients - population inversion - Nd-YAG laser, CO_2 laser, semiconductor laser –Basic applications of lasers in industry.

UNIT IV BASIC QUANTUM MECHANICS 9

Photons and light waves - Electrons and matter waves –Compton effect - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization –Free

particle - particle in a infinite potential well: 1D,2D and 3D Boxes- Normalization, probabilities and the correspondence principle.

UNIT V APPLIED QUANTUM MECHANICS 9

The harmonic oscillator(qualitative)- Barrier penetration and quantum tunneling(qualitative)- Tunneling microscope - Resonant diode - Finite potential wells (qualitative)- Bloch's theorem for particles in a periodic potential –Basics of Kronig-Penney model and origin of energy bands.

TOTAL: 45 PERIODS

COURSE OUTCOMES

After completion of this course, the students should be able to

- Understand the importance of mechanics.
- Express their knowledge in electromagnetic waves.
- Demonstrate a strong foundational knowledge in oscillations, optics and lasers.
- Understand the importance of quantum physics.
- Comprehend and apply quantum mechanical principles towards the formation of energy bands.

TEXT BOOKS:

1. D.Kleppner and R.Kolenkow. An Introduction to Mechanics. McGraw Hill Education (Indian Edition), 2017.
2. E.M.Purcell and D.J.Morin, Electricity and Magnetism, Cambridge Univ.Press, 2013.
3. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, McGraw-Hill (Indian Edition), 2017.

REFERENCES:

1. R.Wolfson. Essential University Physics. Volume 1 & 2. Pearson Education (Indian Edition), 2009.
2. Paul A. Tipler, Physic – Volume 1 & 2, CBS, (Indian Edition), 2004.
3. K.Thyagarajan and A.Ghatak. Lasers: Fundamentals and Applications, Laxmi Publications, (Indian Edition), 2019.
4. D.Halliday, R.Resnick and J.Walker. Principles of Physics, Wiley (Indian Edition), 2015.
5. N.Garcia, A.Damask and S.Schwarz. Physics for Computer Science Students. Springer- Verlag, 2012.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	1	1	1	-	-	-	-	-	-	-	-	-
2	3	3	2	1	2	1	-	-	-	-	-	-	-	-	-
3	3	3	2	2	2	1	-	-	-	-	-	1	-	-	-
4	3	3	1	1	2	1	-	-	-	-	-	-	-	-	-
5	3	3	1	1	2	1	-	-	-	-	-	-	-	-	-
Avg.	**3**	**3**	**1.6**	**1.2**	**1.8**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**

- 1-low, 2-medium, 3-high, '-"- no correlation

Note: The average value of this course to be used for program articulation matrix.

24CY3151 ENGINEERING CHEMISTRY L T P C
3 0 0 3

COURSE OBJECTIVES:

- To inculcate sound understanding of water quality parameters and water treatment techniques.
- To impart knowledge on the basic principles and preparatory methods of nanomaterials.
- To introduce the basic concepts and applications of phase rule and composites.
- To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.
- To familiarize the students with the operating principles, working processes and applications of energy conversion and storage devices.

UNIT I WATER AND ITS TREATMENT 9

Water: Sources and impurities, Water quality parameters: Definition and significance of-color, odour, turbidity, pH, hardness, alkalinity, TDS, COD and BOD, fluoride and arsenic. Municipal water treatment: primary treatment and disinfection (UV, Ozonation, break-point chlorination). Desalination of brackish water: Reverse Osmosis. Boiler troubles: Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming &foaming. Treatment of boiler feed water: Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and External treatment – Ion exchange demineralization and zeolite process.

UNIT II NANOCHEMISTRY 9

Basics: Distinction between molecules, nanomaterials and bulk materials; Size-dependent properties (optical, electrical, mechanical and magnetic); Types of nanomaterials: Definition, properties and uses of – nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. Applications of nanomaterials in medicine, agriculture, energy, electronics and catalysis.

UNIT III PHASE RULE AND COMPOSITES 9

Phase rule: Introduction, definition of terms with examples. One component system - water system; Reduced phase rule; Construction of a simple eutectic phase diagram - Thermal analysis; Two component system: lead-silver system - Pattinson process.

Composites: Introduction: Definition & Need for composites; Constitution: Matrix materials (Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (fiber, particulates, flakes and whiskers). Properties and applications of: Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. Hybrid composites - definition and examples.

UNIT IV FUELS AND COMBUSTION 9

Fuels: Introduction: Classification of fuels; Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel: Manufacture of synthetic petrol (Bergius process), Knocking - octane number, diesel oil - cetane number; Power alcohol and biodiesel.

Combustion of fuels: Introduction: Calorific value - higher and lower calorific values, Theoretical calculation of calorific value; Ignition temperature: spontaneous ignition temperature, Explosive range; Flue gas analysis - ORSAT Method. CO_2 emission and carbon foot print.

UNIT V ENERGY SOURCES AND STORAGE DEVICES 9

Stability of nucleus: mass defect (problems), binding energy; Nuclear energy: light water nuclear power plant, breeder reactor. Solar energy conversion: Principle, working and applications of solar cells; Recent developments in solar cell materials. Wind energy; Geothermal energy; Batteries: Types of batteries, Primary battery - dry cell, Secondary battery - lead acid battery and lithium-ion-battery; Electric vehicles – working principles; Fuel cells: H_2-O_2 fuel cell, microbial fuel cell; Supercapacitors: Storage principle, types and examples.

TOTAL: 45 PERIODS

COURSE OUTCOMES

At the end of the course, the students will be able:

- To infer the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.
- To identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.
- To apply the knowledge of phase rule and composites for material selection requirements.
- To recommend suitable fuels for engineering processes and applications.
- To recognize different forms of energy resources and apply them for suitable applications in energy sectors.

TEXT BOOKS:

1. P. C. Jain and Monica Jain, "Engineering Chemistry", 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2018.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008.
3. S.S. Dara, "A Text book of Engineering Chemistry", S. Chand Publishing, 12th Edition, 2018.

REFERENCES:

1. B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, "Text book of nanoscience and nanotechnology", Universities Press-IIM Series in Metallurgy and Materials Science, 2018.
2. O.G. Palanna, "Engineering Chemistry" McGraw Hill Education (India) Private Limited, 2nd Edition, 2017.
3. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
4. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge UniversityPress, Delhi, Second Edition, 2019.
5. O.V. Roussak and H.D. Gesser, Applied Chemistry-A Text Book for Engineers and Technologists, Springer Science Business Media, New York, 2nd Edition, 2013.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	1	-	1	1	-	-	-	-	1	-	-	-
2	2	-	-	1	-	2	2	-	-	-	-	-	-	-	-
3	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
4	3	1	1	-	-	1	2	-	-	-	-	-	-	-	-
5	3	1	2	1	-	2	2	-	-	-	-	2	-	-	-
Avg.	**2.8**	**1.3**	**1.6**	**1**	**-**	**1.5**	**1.8**	**-**	**-**	**-**	**-**	**1.5**	**-**	**-**	**-**

- 1-low, 2-medium, 3-high, '-"- no correlation

Note: The average value of this course to be used for program articulation matrix.

24GE3151 PROBLEM SOLVING AND PYTHON PROGRAMMING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the basics of algorithmic problem solving.
- To learn to solve problems using Python conditionals and loops.
- To define Python functions and use function calls to solve problems.
- To use Python data structures - lists, tuples, dictionaries to represent complex data.
- To do input/output with files in Python.

UNIT I COMPUTATIONAL THINKING AND PROBLEM SOLVING 9

Fundamentals of Computing – Identification of Computational Problems -Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II DATA TYPES, EXPRESSIONS, STATEMENTS 9

Python interpreter and interactive mode, debugging; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III CONTROL FLOW, FUNCTIONS, STRINGS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV LISTS, TUPLES, DICTIONARIES 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.

UNIT V FILES, MODULES, PACKAGES 9

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter's age validation, Marks range validation (0-100).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1: Develop algorithmic solutions to simple computational problems.
CO2: Develop and execute simple Python programs.
CO3: Write simple Python programs using conditionals and looping for solving problems.
CO4: Decompose a Python program into functions.
CO5: Represent compound data using Python lists, tuples, dictionaries etc.
CO6: Read and write data from/to files in Python programs.

TEXT BOOKS:

1. Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.
2. Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and programming", 1st Edition, BCS Learning & Development Limited, 2017.

REFERENCES:

1. Paul Deitel and Harvey Deitel, “Python for Programmers”, Pearson Education, 1st Edition, 2021.
2. G Venkatesh and Madhavan Mukund, “Computational Thinking: A Primer for Programmers and Data Scientists”, 1st Edition, Notion Press, 2021.
3. John V Guttag, “Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data‘‘, Third Edition, MIT Press 2021.
4. Eric Matthes, “Python Crash Course, A Hands - on Project Based Introduction to Programming”, 2nd Edition, No Starch Press, 2019.
5. Martin C. Brown, “Python: The Complete Reference”, 4th Edition, Mc-Graw Hill, 2018.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	2	-	-	-	-	-	2	2	3	3	-
2	3	3	3	3	2	-	-	-	-	-	2	2	3	-	-
3	3	3	3	3	2	-	-	-	-	-	2	-	3	-	-
4	2	2	-	2	2	-	-	-	-	-	1	-	3	-	-
5	1	2	-	-	1	-	-	-	-	-	1	-	2	-	-
Avg.	**2**	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**2**	**-**	**-**

- 1-low, 2-medium, 3-high, ‘-“- no correlation

Note: The average value of this course to be used for program articulation matrix.

24GE3152 **தமிழர் மரபு** **L T P C**
1 0 0 1

அலகு I மொழி மற்றும் இலக்கியம்: 3

இந்திய மொழிக் குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி - தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை - சங்க இலக்கியத்தில் பகிர்தல் அறம் - திருக்குறளில் மேலாண்மைக் கருத்துக்கள் - தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு II மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை -சிற்பக் கலை: 3

நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள் - பழங்குடியினர் தேர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் செய்யும் கலை சுடுமண் சிற்பங்கள் நாட்டுப்புறத் தெய்வங்கள் குமரிமுனையில் திருவள்ளுவர் சிலை - இசைக் கருவிகள் - மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு III நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்: 3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின்

விளையாட்டுகள்.

அலகு IV தமிழர்களின் திணைக் கோட்பாடுகள்: 3

தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் சங்ககால நகரங்களும் துறை முகங்களும் சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு: 3

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுயமரியாதை இயக்கம் இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு - கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

TOTAL: 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு மக்களும் பண்பாடும் கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு).
4. பொருநை - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு).
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	-	-	-	-	-	3	3	2	-	2	-	2	-	-	-
2	-	-	-	-	-	3	3	2	-	2	-	2	-	-	-
3	-	-	-	-	-	3	3	2	-	2	-	2	-	-	-
4	-	-	-	-	-	3	3	2	-	2	-	2	-	-	-
5	-	-	-	-	-	3	3	2	-	2	-	2	-	-	-
Avg.	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**2**	**-**	**2**	**-**	**2**	**-**	**-**	**-**

- 1-low, 2-medium, 3-high, '-"- no correlation

Note: The average value of this course to be used for program articulation matrix.

24GE3152 **HERITAGE OF TAMILS** **L T P C**
1 0 0 1

UNIT I LANGUAGE AND LITERATURE 3

Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

UNIT II HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE 3

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

UNIT III FOLK AND MARTIAL ARTS 3

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT IV THINAI CONCEPT OF TAMILS 3

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE 3

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

TOTAL: 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு மக்களும் பண்பாடும் கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு).
4. பொருநை - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு).
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	-	-	-	-	-	3	3	2	-	2	-	2	-	-	-
2	-	-	-	-	-	3	3	2	-	2	-	2	-	-	-
3	-	-	-	-	-	3	3	2	-	2	-	2	-	-	-
4	-	-	-	-	-	3	3	2	-	2	-	2	-	-	-
5	-	-	-	-	-	3	3	2	-	2	-	2	-	-	-
Avg.	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**2**	**-**	**2**	**-**	**2**	**-**	**-**	**-**

- 1-low, 2-medium, 3-high, '-"- no correlation

Note: The average value of this course to be used for program articulation matrix.

24GE3171 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY L T P C
0 0 4 2

COURSE OBJECTIVES:

- To understand the problem-solving approaches.
- To learn the basic programming constructs in Python.
- To practice various computing strategies for Python-based solutions to real world problems.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python.

EXPERIMENTS:

Note: The examples suggested in each experiment are only indicative. The lab instructor is expected to design other problems on similar lines. The Examination shall not be restricted to the sample experiments listed here.

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)
2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)
4. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building–operations of list & tuples)
5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries)
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)
7. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)
8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy, Matplotlib, scipy)
9. Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word)
10. Implementing real-time/technical applications using Exception handling. (divide by zero error, voter's age validity, student mark range validation)
11. Exploring Pygame tool.
12. Developing a game activity using Pygame like bouncing ball, car race etc.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

On completion of the course, students will be able to:

CO1: Develop algorithmic solutions to simple computational problems
CO2: Develop and execute simple Python programs.
CO3: Implement programs in Python using conditionals and loops for solving problems.
CO4: Deploy functions to decompose a Python program.
CO5: Process compound data using Python data structures.
CO6: Utilize Python packages in developing software applications.

TEXT BOOKS:

1. Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.
2. Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.

REFERENCES:

1. Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021.
2. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.
3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", Third Edition, MIT Press, 2021.
4. Eric Matthes, "Python Crash Course, A Hands - on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019.
5. https://www.python.org/
6. Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2018.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	3	-	-	-	-	-	3	2	3	3	3
2	3	3	3	3	3	-	-	-	-	-	3	2	3	3	3
3	3	3	3	3	2	-	-	-	-	-	2	-	3	3	3
4	3	2	-	2	2	-	-	-	-	-	1	-	3	3	3
5	1	2	-	-	1	-	-	-	-	-	1	-	2	1	1
Avg.	**2**	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**3**	**3**	**3**

- 1-low, 2-medium, 3-high, '-"- no correlation

Note: The average value of this course to be used for program articulation matrix.

24BS3171 PHYSICS AND CHEMISTRY LABORATORY

L	T	P	C
0	0	4	2

PHYSICS LABORATORY: (Any Seven Experiments)

COURSE OBJECTIVES:

- To learn the proper use of various kinds of physics laboratory equipment.
- To learn how data can be collected, presented and interpreted in a clear and concise manner.
- To learn problem solving skills related to physics principles and interpretation of experimental data.
- To determine error in experimental measurements and techniques used to minimize such error.
- To make the student as an active participant in each part of all lab exercises.

EXPERIMENTS:

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of regular and irregular objects.
2. Simple harmonic oscillations of cantilever.

3. Non-uniform bending - Determination of Young's modulus
4. Uniform bending – Determination of Young's modulus
5. Laser- Determination of the wave length of the laser using grating
6. Air wedge - Determination of thickness of a thin sheet/wire
7. a) Optical fibre -Determination of Numerical Aperture and acceptance angle
   b) Compact disc- Determination of width of the groove using laser.
8. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
9. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
10. Post office box -Determination of Band gap of a semiconductor.
11. Photoelectric effect
12. Michelson Interferometer.
13. Melde's string experiment
14. Experiment with lattice dynamics kit.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students should be able to

- Understand the functioning of various physics laboratory equipment.
- Use graphical models to analyze laboratory data.
- Use mathematical models as a medium for quantitative reasoning and describing physical reality.
- Access, process and analyze scientific information.
- Solve problems individually and collaboratively.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-
2	3	3	2	1	1	-	-	-	-	-	-	-	-	-	-
3	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-
4	3	3	2	1	1	-	-	-	-	-	-	-	-	-	-
5	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-
Avg.	**3**	**2.4**	**2.6**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

- 1-low, 2-medium, 3-high, '-"- no correlation

Note: The average value of this course to be used for program articulation matrix.

CHEMISTRY LABORATORY: (Any seven experiments to be conducted)

COURSE OBJECTIVES:

- To inculcate experimental skills to test basic understanding of water quality parameters, such as, acidity, alkalinity, hardness, DO, chloride and copper.
- To induce the students to familiarize with electroanalytical techniques such as, pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions.
- To demonstrate the analysis of metals and alloys.
- To demonstrate the synthesis of nanoparticles

EXPERIMENTS:

1. Preparation of Na_2CO_3 as a primary standard and estimation of acidity of a water sampleusing the primary standard
2. Determination of types and amount of alkalinity in water sample.
   - Split the first experiment into two
3. Determination of total, temporary & permanent hardness of water by EDTA method.
4. Determination of DO content of water sample by Winkler's method.
5. Determination of chloride content of water sample by Argentometric method.
6. Estimation of copper content of the given solution by Iodometry.

7. Estimation of TDS of a water sample by gravimetry.
8. Determination of strength of given hydrochloric acid using pH meter.
9. Determination of strength of acids in a mixture of acids using conductivity meter.
10. Conductometric titration of barium chloride against sodium sulphate (precipitation titration)
11. Estimation of iron content of the given solution using potentiometer.
12. Estimation of sodium /potassium present in water using flame photometer.
13. Preparation of nanoparticles (TiO_2/ZnO/CuO) by Sol-Gel method.
14. Estimation of Nickel in steel.
15. Proximate analysis of Coal.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

- To analyse the quality of water samples with respect to their acidity, alkalinity, hardness and DO.
- To determine the amount of metal ions through volumetric and spectroscopic techniques.
- To analyse and determine the composition of alloys.
- To learn simple method of synthesis of nanoparticles.
- To quantitatively analyse the impurities in solution by electroanalytical techniques.

TEXT BOOK:

1. J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas and B. Sivasankar, Vogel's Textbook of Quantitative Chemical Analysis (2009).

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	-	1	-	-	2	2	-	-	-	-	2	-	-	-
2	3	1	2	-	-	1	2	-	-	-	-	1	-	-	-
3	3	2	1	1	-	-	1	-	-	-	-	-	-	-	-
4	2	1	2	-	-	2	2	-	-	-	-	-	-	-	-
5	2	1	2	-	1	2	2	-	-	-	-	1	-	-	-
Avg.	**2.6**	**1.3**	**1.6**	**1**	**1**	**1.4**	**1.8**	**-**	**-**	**-**	**-**	**1.3**	**-**	**-**	**-**

- 1-low, 2-medium, 3-high, '-"- no correlation

Note: The average value of this course to be used for program articulation matrix.

24GE3172 ENGLISH LABORATORY L T P C
0 0 2 1

OBJECTIVES:

- To improve the communicative competence of learners.
- To help learners use language effectively in academic /work contexts.
- To develop various listening strategies to comprehend various types of audio materials likelectures, discussions, videos etc.
- To build on students' English language skills by engaging them in listening, speaking andgrammar learning activities that are relevant to authentic contexts.
- To use language efficiently in expressing their opinions via various media.

UNIT I INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION 6

Listening for general information-specific details- conversation: Introduction to classmates - Audio / video (formal & informal); Telephone conversation; Listening to voicemail & messages; Listening and filling a form. Speaking - making telephone calls-Self Introduction; Introducing a friend; - politeness strategies- making polite requests, making polite offers, replying to polite requests and

offers- understanding basic instructions (filling out a bank application for example).

UNIT II NARRATION AND SUMMATION 6

Listening - Listening to podcasts, anecdotes / stories / event narration; documentaries and interviews with celebrities. Speaking - Narrating personal experiences / events-Talking about current and temporary situations & permanent and regular situations* - describing experiences and feelings- engaging in small talk- describing requirements and abilities.

UNIT III DESCRIPTION OF A PROCESS / PRODUCT 6

Listening - Listen to product and process descriptions; a classroom lecture; and advertisements about products. Speaking – Picture description- describing locations in workplaces- Giving instruction to use the product- explaining uses and purposes- Presenting a product- describing shapes and sizes and weights- talking about quantities (large & small)-talking about precautions.

UNIT IV CLASSIFICATION AND RECOMMENDATIONS 6

Listening – Listening to TED Talks; Listening to lectures - and educational videos. Speaking – Small Talk; discussing and making plans-talking about tasks-talking about progress- talking about positions and directions of movement-talking about travel preparations- talking about transportation.

UNIT V EXPRESSION 6

Listening – Listening to debates/ discussions; different viewpoints on an issue; and panel discussions. Speaking –making predictions- talking about a given topic-giving opinions- understanding a website- describing processes.

TOTAL: 30 PERIODS

LEARNING OUTCOMES:

At the end of the course, learners will be able

- To listen to and comprehend general as well as complex academic information.
- To listen to and understand different points of view in a discussion.
- To speak fluently and accurately in formal and informal communicative contexts.
- To describe products and processes and explain their uses and purposes clearly and accurately
- To express their opinions effectively in both formal and informal discussions.

ASSESSMENT PATTERN

- One online / app-based assessment to test listening /speaking.
- End Semester **ONLY** listening and speaking will be conducted online.
- Proficiency certification is given on successful completion of listening and speaking internal testand end semester exam.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	1	3	3	3	3	3	3	3	-	-	-
2	3	3	3	3	1	3	3	3	3	3	3	3	-	-	-
3	3	3	3	3	1	3	3	3	3	3	3	3	-	-	-
4	3	3	3	3	1	3	3	3	3	3	3	3	-	-	-
5	3	3	3	3	1	3	3	3	3	3	3	3	-	-	-
Avg.	**3**	**3**	**3**	**3**	**1**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	-	-	-

- 1-low, 2-medium, 3-high, '-"- no correlation

Note: The average value of this course to be used for program articulation matrix.

24HS3252	PROFESSIONAL ENGLISH – II	L T P C 2 0 0 2

OBJECTIVES:

- To engage learners in meaningful language activities to improve their reading and writing skills.
- To learn various reading strategies and apply in comprehending documents in professional context.
- To help learners understand the purpose, audience, contexts of different types of writing.
- To develop analytical thinking skills for problem solving in communicative contexts.
- To demonstrate an understanding of job applications and interviews for internship and placements.

UNIT I MAKING COMPARISONS 6

Reading - Reading advertisements, user manuals, brochures; Writing – Professional emails, Email etiquette - Compare and Contrast Essay; Grammar – Mixed Tenses, Prepositional phrases

UNIT II EXPRESSING CAUSAL RELATIONS IN SPEAKING AND WRITING 6

Reading - Reading longer technical texts– Cause and Effect Essays, and Letters / emails of complaint, Writing - Writing responses to complaints. Grammar - Active Passive Voice transformations, Infinitive and Gerunds

UNIT III PROBLEM SOLVING 6

Reading - Case Studies, excerpts from literary texts, news reports etc. Writing – Letter to the Editor, Checklists, Problem solution essay / Argumentative Essay. Grammar – Error correction; If conditional sentences

UNIT IV REPORTING OF EVENTS AND RESEARCH 6

Reading –Newspaper articles; Writing – Recommendations, Transcoding, Accident Report, Survey Report Grammar – Reported Speech, Modals Vocabulary – Conjunctions- use of prepositions

UNIT V THE ABILITY TO PUT IDEAS OR INFORMATION COGENTLY 6

Reading – Company profiles, Statement of Purpose, (SOP), an excerpt of interview with professionals; Writing – Job / Internship application – Cover letter & Resume; Grammar – Numerical adjectives, Relative Clauses.

TOTAL: 30 PERIODS

OUTCOMES:

At the end of the course, learners will be able

- To compare and contrast products and ideas in technical texts.
- To identify and report cause and effects in events, industrial processes through technical texts
- To analyse problems in order to arrive at feasible solutions and communicate them in the written format.
- To present their ideas and opinions in a planned and logical manner.
- To draft effective resumes in the context of job search.

TEXT BOOKS:

1. English for Engineers & Technologists (2020 edition) Orient Blackswan Private Ltd. Departmentof English, Anna University.
2. English for Science & Technology Cambridge University Press 2021.
3. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN.Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.

REFERENCES:

1. Raman. Meenakshi, Sharma. Sangeeta (2019). Professional English. Oxford university

press.New Delhi.
2. Improve Your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, New Delhi.
3. Learning to Communicate – Dr. V. Chellammal. Allied Publishers, New Delhi, 2003.
4. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, TataMcGraw Hill & Co. Ltd., 2001, New Delhi.
5. Developing Communication Skills by Krishna Mohan, Meera Bannerji- Macmillan India Ltd. 1990,Delhi.

ASSESSMENT PATTERN

Two internal assessments and an end semester examination to test students' reading and writing skillsalong with their grammatical and lexical competence.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	3	3	3	3	2	3	3	3	-	-	-
2	3	3	3	3	3	3	3	3	2	3	3	3	-	-	-
3	3	3	3	3	3	3	3	3	2	3	3	3	-	-	-
4	3	3	3	3	2	3	3	3	2	3	3	3	-	-	-
5	-	-	-	-	-	-	-	-	3	3	3	3	-	-	-
Avg.	**3**	**3**	**3**	**3**	**2.75**	**3**	**3**	**3**	**2.2**	**3**	**3**	**3**	**-**	**-**	**-**

- 1-low, 2-medium, 3-high, '-"- no correlation

Note: The average value of this course to be used for program articulation matrix.

24MA3251 STATISTICS AND NUMERICAL METHODS L T P C
3 1 0 4

COURSE OBJECTIVES:

- This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

UNIT I TESTING OF HYPOTHESIS 9+3

Sampling distributions - Tests for single mean, proportion and difference of means (Large and small samples) – Tests for single variance and equality of variances – Chi square test for goodness of fit – Independence of attributes.

UNIT II DESIGN OF EXPERIMENTS 9+3

One way and two-way classifications - Completely randomized design – Randomized block design – Latin square design - 2^2 factorial design.

UNIT III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 9+3

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method- Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a matrix by

Power method and Jacobi's method for symmetric matrices.

UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION 9+3

Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivates using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.

UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 9+3

Single step methods: Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first order differential equations - Multi step methods: Milne's and Adams - Bash forth predictor corrector methods for solving first order differential equations.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to:

- Apply the concept of testing of hypothesis for small and large samples in real life problems.
- Apply the basic concepts of classifications of design of experiments in the field of agriculture.
- Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.
- Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
- Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

TEXT BOOKS:

1. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.
2. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.

REFERENCES:

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
3. Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 7th Edition, 2007.
4. Gupta S.C. and Kapoor V. K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 12th Edition, 2020.
5. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outlines on Probability and Statistics ", Tata McGraw Hill Edition, 4th Edition, 2012.
6. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education, Asia, 2010.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	1	1	1	-	-	-	2	-	2	3	-	-	-
2	3	3	1	1	1	-	-	-	2	-	2	3	-	-	-
3	3	3	1	1	1	-	-	-	2	-	2	3	-	-	-
4	3	3	1	1	1	-	-	-	2	-	2	3	-	-	-
5	3	3	1	1	1	-	-	-	2	-	2	3	-	-	-
Avg.	**3**	**3**	**1**	**1**	**1**	**-**	**-**	**-**	**2**	**-**	**2**	**3**	**-**	**-**	**-**

- 1-low, 2-medium, 3-high, '-"- no correlation

Note: The average value of this course to be used for program articulation matrix.

24PH3251 **MATERIALS SCIENCE** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To make the students to understand the basics of crystallography and its importance in studying materials properties.
- To understand the electrical properties of materials including free electron theory, applications of quantum mechanics and magnetic materials.
- To instil knowledge on physics of semiconductors, determination of charge carriers and device applications
- To establish a sound grasp of knowledge on different optical properties of materials, optical displays and applications
- To inculcate an idea of significance of nano structures, quantum confinement and ensuing nano device applications.

UNIT I CRYSTALLOGRAPHY 9

Crystal structures: BCC, FCC and HCP – directions and planes - linear and planar densities – crystal imperfections- edge and screw dislocations – grain and twin boundaries - Burgers vector and elastic strain energy- Slip systems, plastic deformation of materials - Polymorphism – phase changes – nucleation and growth – homogeneous and heterogeneous nucleation.

UNIT II ELECTRICAL AND MAGNETIC PROPERTIES OF MATERIALS 9

Classical free electron theory - Expression for electrical conductivity – Thermal conductivity, expression - Quantum free electron theory: Tunneling – degenerate states – Fermi- Dirac statistics – Density of energy states – Electron in periodic potential – Energy bands in solids – tight binding approximation - Electron effective mass – concept of hole. Magnetic materials: Dia, para and ferromagnetic effects – paramagnetism in the conduction electrons in metals – exchange interaction and ferromagnetism – quantum interference devices – GMR devices.

UNIT III SEMICONDUCTORS AND TRANSPORT PHYSICS 9

Intrinsic Semiconductors – Energy band diagram – direct and indirect band gap semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors – Variation of carrier concentration with temperature – Carrier transport in Semiconductors: Drift, mobility and diffusion – Hall effect and devices – Ohmic contacts – Schottky diode.

UNIT IV OPTICAL PROPERTIES OF MATERIALS 9

Classification of optical materials – Optical processes in semiconductors: optical absorption and emission, charge injection and recombination, optical absorption, loss and gain. Optical processes in quantum wells – Optoelectronic devices: light detectors and solar cells – light emitting diode – laser diode - optical processes in organic semiconductor devices –excitonic state – Electro-optics and nonlinear optics: Modulators and switching devices – plasmonics.

UNIT V NANOELECTRONIC DEVICES 9

Quantum confinement – Quantum structures – quantum wells, wires and dots – Zener-Bloch oscillations – Resonant tunneling – quantum interference effects - mesoscopic structures - Single electron phenomena – Single electron Transistor. Semiconductor photonic structures – 1D, 2D and 3D photonic crystal. Active and passive optoelectronic devices – photo processes – spintronics – carbon nanotubes: Properties and applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students should be able to

- know basics of crystallography and its importance for varied materials properties.
- gain knowledge on the electrical and magnetic properties of materials and their applications.
- understand clearly of semiconductor physics and functioning of semiconductor devices.
- understand the optical properties of materials and working principles of various optical devices.
- appreciate the importance of functional nano electronic devices.

TEXT BOOKS:

1. V.Raghavan, Materials Science and Engineering: A First Course, Prentice Hall India Learning Private Limited, 2015.
2. S.O. Kasap, Principles of Electronic Materials and Devices, Mc-Graw Hill, 2018.
3. Jasprit Singh, Semiconductor Devices: Basic Principles, Wiley (India), 2007.
4. Jasprit Singh, Semiconductor Optoelectronics: Physics and Technology, Mc-Graw Hill India (2019).
5. G.W.Hanson, Fundamentals of Nanoelectronics. Pearson Education (Indian Edition), 2009.

REFERENCES:

1. R.Balasubramaniam, Callister's Materials Science and Engineering. Wiley (Indian Edition), 2014.
2. Wendelin Wright and Donald Askeland, Essentials of Materials Science and Engineering, CL Engineering, 2013.
3. Robert F.Pierret, Semiconductor Device Fundamentals, Pearson, 2006.
4. Pallab Bhattacharya, Semiconductor Optoelectronic Devices, Pearson, 2017.
5. Ben Rogers, Jesse Adams and Sumita Pennathur, Nanotechnology: Understanding Small Systems, CRC Press, 2017.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	2	1	1	-	-	-	-	-	-	-	-	-
2	3	2	1	1	2	1	1	-	-	-	-	-	-	-	-
3	3	2	2	2	2	1	-	-	-	-	-	-	-	-	-
4	3	2	2	1	2	2	-	-	-	-	-	1	-	-	-
5	3	2	2	1	2	1	-	-	-	-	-	-	-	-	-
Avg.	**3**	**2**	**1.6**	**1.4**	**1.8**	**1.2**	**1**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**

- 1-low, 2-medium, 3-high, '-"- no correlation

Note: The average value of this course to be used for program articulation matrix.

24BE3251 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce the basics of electric circuits and analysis.
- To impart knowledge in the basics of working principles and application of electrical machines.
- To introduce analog devices and their characteristics.
- To educate on the fundamental concepts of digital electronics.
- To introduce the functional elements and working of measuring instruments.

UNIT I ELECTRICAL CIRCUITS 9

DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm's Law - Kirchhoff's Laws –Independent and Dependent Sources – Simple problems- Nodal Analysis, Mesh analysis with Independent sources only (Steady state)

Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor – Steady state analysis of RLC circuits (Simple problems only)

UNIT II ELECTRICAL MACHINES 9

Construction and Working principle- DC Separately and Self excited Generators, EMF equation, Types and Applications. Working Principle of DC motors, Torque Equation, Types and Applications. Construction, Working principle and Applications of Transformer, Three phase Alternator,

Synchronous motor and Three Phase Induction Motor.

UNIT III ANALOG ELECTRONICS 9

Resistor, Inductor and Capacitor in Electronic Circuits- Semiconductor Materials: Silicon &Germanium – PN Junction Diodes, Zener Diode –Characteristics Applications – Bipolar Junction Transistor-Biasing, JFET, SCR, MOSFET, IGBT – Types, I-V Characteristics and Applications, Rectifier and Inverters

UNIT IV DIGITAL ELECTRONICS 9

Review of number systems, binary codes, error detection and correction codes, Combinational logic - representation of logic functions-SOP and POS forms, K-map representations - minimization using K maps (Simple Problems only)

UNIT V MEASUREMENTS AND INSTRUMENTATION 9

Functional elements of an instrument, Standards and calibration, Operating Principle, types -Moving Coil and Moving Iron meters, Measurement of three phase power, Energy Meter, Instrument Transformers-CT and PT, DSO- Block diagram- Data acquisition.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completing this course, the students will be able to

1. Compute the electric circuit parameters for simple problems.
2. Explain the working principle and applications of electrical machines.
3. Analyze the characteristics of analog electronic devices.
4. Explain the basic concepts of digital electronics.
5. Explain the operating principles of measuring instruments.

TEXT BOOKS:

1. Kothari DP and I.J Nagrath, “Basic Electrical and Electronics Engineering”, Second Edition, McGraw Hill Education, 2020
2. S.K. Bhattacharya “Basic Electrical and Electronics Engineering”, Pearson Education, Second Edition, 2017.
3. Sedha R.S., “A text book book of Applied Electronics”, S. Chand & Co., 2008.
4. James A. Svoboda, Richard C. Dorf, “Dorf’s Introduction to Electric Circuits”, Wiley, 2018.
5. A.K. Sawhney, Puneet Sawhney ‘A Course in Electrical & Electronic Measurements & Instrumentation’, Dhanpat Rai and Co, 2015.

REFERENCES:

1. Kothari DP and I.J Nagrath, “Basic Electrical Engineering”, Fourth Edition, McGraw Hill Education, 2019.
2. Thomas L. Floyd, ‘Digital Fundamentals’, 11th Edition, Pearson Education, 2017.
3. Albert Malvino, David Bates, ‘Electronic Principles, McGraw Hill Education; 7th edition, 2017.
4. Mahmood Nahvi and Joseph A. Edminister, “Electric Circuits”, Schaum’ Outline Series, McGrawHill, 2002.
5. H.S. Kalsi, ‘Electronic Instrumentation’, Tata McGraw-Hill, New Delhi, 2010.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	1	-	-	-	-	1	-	-	-	2	-	-	1
2	2	2	1	-	-	-	-	1	-	-	-	2	-	-	1
3	2	1	1	-	-	-	-	1	-	-	-	2	-	-	1
4	2	2	1	-	-	-	-	1	-	-	-	2	-	-	1
5	2	2	1	-	-	-	-	1	-	-	-	2	-	-	1
Avg.	**2**	**1.8**	**1**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**2**	**-**	**-**	**1**

- 1-low, 2-medium, 3-high, ‘-“- no correlation

Note: The average value of this course to be used for program articulation matrix.

24GE3251	ENGINEERING GRAPHICS	L	T	P	C
		2	0	4	4

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

1. Drawing engineering curves.
2. Drawing freehand sketch of simple objects.
3. Drawing orthographic projection of solids and section of solids.
4. Drawing development of solids
5. Drawing isometric and perspective projections of simple solids.

CONCEPTS AND CONVENTIONS (Not for Examination)

Importance of graphics in engineering applications - Use of drafting instruments - BIS conventions andspecifications — Size, layout and folding of drawing sheets — Lettering and dimensioning.

UNIT I PLANE CURVES 6+12

Basic Geometrical constructions, Curves used in engineering practices: Conics — Construction of ellipse, parabola and hyperbola by eccentricity method — Construction of cycloid — construction of involutes of square and circle — Drawing of tangents and normal to the above curves.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE 6+12

Orthographic projection - principles-Principal planes - First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS AND FREEHAND SKETCHING 6+12

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes and parallel to the other by rotating object method. Visualization concepts and Free Hand sketching: Visualization principles —Representation of Three Dimensional objects — Layout of views- Freehand sketching of multiple views from pictorial views of objects.

Practicing three-dimensional modeling of simple objects by CAD Software (Not for examination)

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 6 +12

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other — obtaining true shape of section. Development oflateral surfaces of simple and sectioned solids — Prisms, pyramids cylinders and cones.

Practicing three-dimensional modeling of simple objects by CAD Software (Not for examination)

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 6+12

Principles of isometric projection — isometric scale - Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple verticalpositions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.

Practicing three-dimensional modeling of isometric projection of simple objects by CAD Software (Notfor examination)

TOTAL: (L=30; P=60) 90 PERIODS

OUTCOMES:

On successful completion of this course, the student will be able to

- Use BIS conventions and specifications for engineering drawing.
- Construct the conic curves, involutes and cycloid.
- Solve practical problems involving projection of lines.
- Draw the orthographic, isometric and perspective projections of simple solids.
- Draw the development of simple solids.

TEXT BOOK:

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 53 Edition, 2019.
2. Natrajan K.V., "A Text Book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2018.
3. Parthasarathy, N. S. and Vela Murali, "Engineering Drawing", Oxford University Press, 2015.

REFERENCES:

1. Basant Agarwal and Agarwal C.M., "Engineering Drawing", McGraw Hill, 2nd Edition, 2019.
2. Gopalakrishna K.R., "Engineering Drawing" (Vol. I & II combined), Subhas Publications, Bangalore,27th Edition,2017.
3. Luzzader, Warren.J. and Duff, John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
4. Parthasarathy N. S. and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi,2015.
5. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson Education India, 2nd Edition, 2009.
6. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008.

Publication of Bureau of Indian Standards:

1. IS 10711 — 2001: Technical products Documentation — Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) — 2001: Technical products Documentation — Lettering.
3. IS 10714 (Part 20) — 2001 & SP 46 — 2003: Lines for technical drawings.
4. IS 11669 — 1986 & SP 46 —2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) — 2001: Technical drawings — Projection Methods.

Special points applicable to University Examinations on Engineering Graphics:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permittedto use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
2	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
3	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
4	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
5	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
Avg.	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-

- 1-low, 2-medium, 3-high, '-"- no correlation

Note: The average value of this course to be used for program articulation matrix.

24GE3252 **தமிழரும் தொழில்நுட்பமும்** **L T P C**
1 0 0 1

அலகு I நெசவு மற்றும் பானைத் தொழில்நுட்பம்: 3

சங்க காலத்தில் நெசவுத் தொழில் பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் - பாண்டங்களில் கீறல் குறியீடுகள்.

அலகு II வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்: 3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் மாமல்லபுரச் சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் சிற்பங்களும், கோவில்களும் - சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் -நாயக்கர் காலக் கோயில்கள் மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாட்டு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ - சாரோசெனிக் கட்டிடக் கலை.

அலகு III உற்பத்தித் தொழில் நுட்பம்: 3

கப்பல் கட்டும் கலை உலோகவியல் இரும்புத் தொழிற்சாலை -இரும்பை உருக்குதல், எஃகு - வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடி மணிகள் - சுடுமண் மணிகள் சங்கு மணிகள் - எலும்புத்துண்டுகள் -தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு IV வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்: 3

அணை, ஏரி, குளங்கள், மதகு - சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன்வளம் முத்து மற்றும் முத்துக்குளித்தல் -பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்.

அலகு V அறிவியல் தமிழ் மற்றும் கணித்தமிழ்: 3

அறிவியல் தமிழின் வளர்ச்சி -கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணையக் கல்விக்கழகம் தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்.

TOTAL: 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு மக்களும் பண்பாடும் கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு).
4. பொருநை - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு).
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print).

6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: InternationalInstitute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: InternationalInstitute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author).
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu).
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	-	-	-	-	-	3	3	2	-	2	-	2	-	-	-
2	-	-	-	-	-	3	3	2	-	2	-	2	-	-	-
3	-	-	-	-	-	3	3	2	-	2	-	2	-	-	-
4	-	-	-	-	-	3	3	2	-	2	-	2	-	-	-
5	-	-	-	-	-	3	3	2	-	2	-	2	-	-	-
Avg.	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**2**	**-**	**2**	**-**	**2**	**-**	**-**	**-**

- 1-low, 2-medium, 3-high, '-"- no correlation

Note: The average value of this course to be used for program articulation matrix.

24GE3252 TAMILS AND TECHNOLOGY L T P C
1 0 0 1

UNIT I WEAVING AND CERAMIC TECHNOLOGY 3

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY 3

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

UNIT III MANUFACTURING TECHNOLOGY 3

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold-Coins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.

UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY 3

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING 3

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

TOTAL: 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு மக்களும் பண்பாடும் கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print).
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: InternationalInstitute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	-	-	-	-	-	3	3	2	-	2	-	2	-	-	-
2	-	-	-	-	-	3	3	2	-	2	-	2	-	-	-
3	-	-	-	-	-	3	3	2	-	2	-	2	-	-	-
4	-	-	-	-	-	3	3	2	-	2	-	2	-	-	-
5	-	-	-	-	-	3	3	2	-	2	-	2	-	-	-
Avg.	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**2**	**-**	**2**	**-**	**2**	**-**	**-**	**-**

- 1-low, 2-medium, 3-high, '-"- no correlation

Note: The average value of this course to be used for program articulation matrix.

NCC CREDIT COURSE LEVEL 1*

		L	T	P	C
24NX3251	**(ARMY WING) NCC Credit Course Level - I**	**2**	**0**	**0**	**2**

NCC GENERAL		**6**
NCC 1	Aims, Objectives & Organization of NCC	1
NCC 2	Incentives	2
NCC 3	Duties of NCC Cadet	1
NCC 4	NCC Camps: Types & Conduct	2

NATIONAL INTEGRATION AND AWARENESS		**4**
NI 1	National Integration: Importance & Necessity	1
NI 2	Factors Affecting National Integration	1
NI 3	Unity in Diversity & Role of NCC in Nation Building	1
NI 4	Threats to National Security	1
PERSONALITY DEVELOPMENT		**7**
PD 1	Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving	2
PD 2	Communication Skills	3
PD 3	Group Discussion: Stress & Emotions	2
LEADERSHIP		**5**
L 1	Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code	3
L 2	Case Studies: Shivaji, Jhasi Ki Rani	2
SOCIAL SERVICE AND COMMUNITY DEVELOPMENT		**8**
SS 1	Basics, Rural Development Programmes, NGOs, Contribution of Youth	3
SS 4	Protection of Children and Women Safety	1
SS 5	Road / Rail Travel Safety	1
SS 6	New Initiatives	2
SS 7	Cyber and Mobile Security Awareness	1

TOTAL: 30 PERIODS

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	-	-	-	-	-	3	-	3	2	2	-	2	-	2	3
2	-	-	-	-	-	3	3	3	-	2	-	2	-	3	2
3	-	2	-	-	-	-	-	2	3	3	-	3	-	2	3
4	-	2	-	-	-	2	-	3	3	3	-	2	-	2	3
5	-	-	-	-	-	3	3	2	-	2	-	3	-	3	2
Avg.	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**2**	**-**	**2**	**-**	**2**	**-**	2	3

- 1-low, 2-medium, 3-high, '-"- no correlation

Note: The average value of this course to be used for program articulation matrix.

NCC Credit Course Level 1*

24NX3252	**(NAVAL WING) NCC Credit Course Level - I**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**
NCC GENERAL					**6**
NCC 1	Aims, Objectives & Organization of NCC				1
NCC 2	Incentives				2
NCC 3	Duties of NCC Cadet				1
NCC 4	NCC Camps: Types & Conduct				2
NATIONAL INTEGRATION AND AWARENESS					**4**
NI 1	National Integration: Importance & Necessity				1
NI 2	Factors Affecting National Integration				1

NI 3	Unity in Diversity & Role of NCC in Nation Building	1
NI 4	Threats to National Security	1
PERSONALITY DEVELOPMENT		**7**
PD 1	Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving	2
PD 2	Communication Skills	3
PD 3	Group Discussion: Stress & Emotions	2
LEADERSHIP		**5**
L 1	Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code	3
L 2	Case Studies: Shivaji, Jhasi Ki Rani	2
SOCIAL SERVICE AND COMMUNITY DEVELOPMENT		**8**
SS 1	Basics, Rural Development Programmes, NGOs, Contribution of Youth	3
SS 4	Protection of Children and Women Safety	1
SS 5	Road / Rail Travel Safety	1
SS 6	New Initiatives	2
SS 7	Cyber and Mobile Security Awareness	1

TOTAL: 30 PERIODS

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	-	-	-	-	-	**3**	-	**3**	**2**	**2**	-	**2**	-	2	3
2	-	-	-	-	-	**3**	**3**	**3**	-	**2**	-	**2**	-	3	2
3	-	**2**	-	-	-	-	-	**2**	**3**	**3**	-	**3**	-	2	3
4	-	**2**	-	-	-	**2**	-	**3**	**3**	**3**	-	**2**	-	2	3
5	-	-	-	-	-	**3**	**3**	**2**	-	**2**	-	**3**	-	3	2
Avg.	**-**	**2**	**-**	**-**	**-**	**3**	**3**	**3**	**3**	**3**	**-**	**3**	**-**	**2**	**3**

- 1-low, 2-medium, 3-high, '-"- no correlation

Note: The average value of this course to be used for program articulation matrix.

NCC Credit Course Level 1*

24NX3253	**(AIR FORCE WING) NCC Credit Course Level - I**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

NCC GENERAL		**6**
NCC 1	Aims, Objectives & Organization of NCC	1
NCC 2	Incentives	2
NCC 3	Duties of NCC Cadet	1
NCC 4	NCC Camps: Types & Conduct	2
NATIONAL INTEGRATION AND AWARENESS		**4**
NI 1	National Integration: Importance & Necessity	1
NI 2	Factors Affecting National Integration	1
NI 3	Unity in Diversity & Role of NCC in Nation Building	1
NI 4	Threats to National Security	1
PERSONALITY DEVELOPMENT		**7**
PD 1	Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving	2

PD 2	Communication Skills	3
PD 3	Group Discussion: Stress & Emotions	2

LEADERSHIP **5**

L 1	Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code	3
L 2	Case Studies: Shivaji, Jhasi Ki Rani	2

SOCIAL SERVICE AND COMMUNITY DEVELOPMENT **8**

SS 1	Basics, Rural Development Programmes, NGOs, Contribution of Youth	3
SS 4	Protection of Children and Women Safety	1
SS 5	Road / Rail Travel Safety	1
SS 6	New Initiatives	2
SS 7	Cyber and Mobile Security Awareness	1

TOTAL: 30 PERIODS

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	-	-	-	-	-	3	-	3	2	2	-	2	-	2	3
2	-	-	-	-	-	3	3	3	-	2	-	2	-	3	2
3	-	2	-	-	-	-	-	2	3	3	-	3	-	2	3
4	-	2	-	-	-	2	-	3	3	3	-	2	-	2	3
5	-	–	-	-	-	3	3	2	-	2	-	3	-	3	2
Avg.	**-**	**2**	**-**	**-**	**-**	**3**	**3**	**3**	**3**	**3**	**-**	**3**	**-**	**2**	**3**

- 1-low, 2-medium, 3-high, '-"- no correlation

Note: The average value of this course to be used for program articulation matrix.

24GE3271 ENGINEERING PRACTICES LABORATORY **L T P C**
0 0 4 2

COURSE OBJECTIVES:

The main learning objective of this course is to provide hands on training to the students in:

1. Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planing; making joints in wood materials used in common household wood work.
2. Wiring various electrical joints in common household electrical wire work.
3. Welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipment's; Making a tray out of metal sheet using sheet metal work.
4. Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.

GROUP – A (CIVIL & ELECTRICAL)

PART I CIVIL ENGINEERING PRACTICES **15**

PLUMBING WORK:

a) Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.

b) Preparing plumbing line sketches.
c) Laying pipe connection to the suction side of a pump
d) Laying pipe connection to the delivery side of a pump.
e) Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

WOOD WORK:

a) Sawing,
b) Planing and
c) Making joints like T-Joint, Mortise joint and Tenon joint and Dovetail joint.

Wood Work Study:

a) Studying joints in door panels and wooden furniture
b) Studying common industrial trusses using models.

PART II ELECTRICAL ENGINEERING PRACTICES 15

a) Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin sockets.
b) Staircase wiring
c) Fluorescent Lamp wiring with introduction to CFL and LED types.
d) Energy meter wiring and related calculations/ calibration
e) Study of Iron Box wiring and assembly
f) Study of Fan Regulator (Resistor type and Electronic type using Diac/Triac/quadrac)
g) Study of emergency lamp wiring/Water heater

GROUP – B (MECHANICAL AND ELECTRONICS)

PART III MECHANICAL ENGINEERING PRACTICES 15

WELDING WORK:

a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
b) Practicing gas welding.

BASIC MACHINING WORK:

a) (simple)Turning.
b) (simple)Drilling.
c) (simple)Tapping.

ASSEMBLY WORK:

a) Assembling a centrifugal pump.
b) Assembling a household mixer.
c) Assembling an air conditioner.

SHEET METAL WORK:

a) Making of a square tray

FOUNDRY WORK:

a) Demonstrating basic foundry operations.

PART IV ELECTRONIC ENGINEERING PRACTICES 15

SOLDERING WORK:

a) Soldering simple electronic circuits and checking continuity.

ELECTRONIC ASSEMBLY AND TESTING WORK:

a) Assembling and testing electronic components on a small PCB.

ELECTRONIC EQUIPMENT STUDY:

a) Study the elements of smart phone.
b) Assembly and dismantle of LED TV.
c) Assembly and dismantle of computer/ laptop

TOTAL = 60 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

1. Draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household wood work.
2. Wire various electrical joints in common household electrical wire work.
3. Weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common household equipment's; Make a tray out of metal sheet using sheet metal work.
4. Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
2	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
3	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
4	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
5	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
Avg.	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1

- 1-low, 2-medium, 3-high, '-"- no correlation

Note: The average value of this course to be used for program articulation matrix.

24BE3271 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY **L T P C 0 0 4 2**

COURSE OBJECTIVES:

- To train the students in conducting load tests on electrical machines
- To gain practical experience in characterizing electronic devices
- To train the students to use DSO for measurements.

LIST OF EXPERIMENTS

1. Verification of ohms and Kirchhoff's Laws.
2. Load test on DC Shunt Motor.
3. Load test on Self Excited DC Generator
4. Load test on Single phase Transformer
5. Load Test on Induction Motor
6. Characteristics of PN and Zener Diodes
7. Characteristics of BJT, SCR and MOSFET
8. Half wave and Full Wave rectifiers
9. Study of Logic Gates
10. Implementation of Binary Adder and Subtractor
11. Study of DSO

TOTAL: 60 PERIODS

COURSE OUTCOMES:

After completing this course, the students will be able to

1. Use experimental methods to verify the Ohm's and Kirchhoff's Laws.
2. Analyze experimentally the load characteristics of electrical machines
3. Analyze the characteristics of basic electronic devices
4. Use DSO to measure the various parameters

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	1	1	-	-	1.5	2	-	-	-	-	-	1
2	3	3	2	1	1	-	-	1.5	2	-	-	-	-	-	1
3	3	3	2	1	1	-	-	1.5	2	-	-	-	-	-	1
4	3	3	2	1	1	-	-	1.5	2	-	-	-	-	-	1
5	3	3	2	1	1	-	-	1.5	2	-	-	-	-	-	1
Avg.	**3**	**3**	**2**	**1**	**1**	**-**	**-**	**1.5**	**2**	**-**	**-**	**-**	**-**	**-**	**1**

- 1-low, 2-medium, 3-high, '-"- no correlation

Note: The average value of this course to be used for program articulation matrix.

24GE3272 COMMUNICATION LABORATORY L T P C
0 0 4 2

OBJECTIVES

- To identify varied group discussion skills and apply them to take part in effective discussions in a professional context.
- To analyse concepts and problems and make effective presentations explaining them clearly and precisely.
- To be able to communicate effectively through formal and informal writing.
- To be able to use appropriate language structures to write emails, reports and essays.
- To give instructions and recommendations that are clear and relevant to the context.

UNIT I **12**

Speaking-Role Play Exercises Based on Workplace Contexts, - talking about competition-discussing progress toward goals-talking about experiences- talking about events in life- discussing past events-Writing: writing emails (formal & semi-formal).

UNIT II **12**

Speaking: discussing news stories-talking about frequency-talking about travel problems-discussing travel procedures- talking about travel problems- making arrangements-describing arrangements-discussing plans and decisions- discussing purposes and reasons- understanding common technology terms-Writing: - writing different types of emails.

UNIT III **12**

Speaking: discussing predictions-describing the climate-discussing forecasts and scenarios- talking about purchasing-discussing advantages and disadvantages- making comparisons- discussing likes and dislikes- discussing feelings about experiences-discussing imaginary scenarios Writing: short essays and reports-formal/semi-formal letters.

UNIT IV **12**

Speaking: discussing the natural environment-describing systems-describing position and movement- explaining rules- (example- discussing rental arrangements)- understanding technical instructions-Writing: writing instructions-writing a short article.

UNIT V **12**

Speaking: describing things relatively-describing clothing-discussing safety issues (making recommendations) talking about electrical devices-describing controlling actions- Writing: job application (Cover letter + Curriculum vitae)-writing recommendations.

TOTAL: 60 PERIODS

LEARNING OUTCOMES

At the end of the course, learners will be able

- Speak effectively in group discussions held in ~~a~~ formal/semi formal contexts.
- Discuss, analyse and present concepts and problems from various perspectives to arrive at suitable solutions.
- Write emails, letters and effective job applications.
- Write critical reports to convey data and information with clarity and precision
- Give appropriate instructions and recommendations for safe execution of tasks

Assessment Pattern

- One online / app-based assessment to test speaking and writing skills
- Proficiency certification is given on successful completion of speaking and writing.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	3	3	3	1	3	3	3	3	3	3	3	-	-	-
2	2	3	3	3	1	3	3	3	3	3	3	3	-	-	-
3	2	2	3	3	1	3	3	3	3	3	3	3	-	-	-
4	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-
5	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-
Avg.	**2.4**	**2.8**	**3**	**3**	**1.8**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**

- 1-low, 2-medium, 3-high, '-"- no correlation

Note: The average value of this course to be used for program articulation matrix.

24MA3352 **PARTIAL DIFFERENTIAL EQUATIONS AND COMPLEX FUNCTIONS**

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.
- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To develop an understanding of the standard techniques of complex variable theory in particular analytic function and its mapping property
- To familiarize the students with complex integration techniques and contour integration techniques which can be used in real integrals.

UNIT-I PARTIAL DIFFERENTIAL EQUATIONS **9+3**

Formation of partial differential equations –Solutions of standard types of first order partial differential equations - First order partial differential equations reducible to standard types-Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT-II FOURIER SERIES **9+3**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series and cosine series – Root mean square value – Parseval's identity – Harmonic analysis.

UNIT-III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS **9+3**

Classification of PDE – Method of separation of variables - Fourier series solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two-dimensional equation of heat conduction (Cartesian coordinates only) (Excluding insulated edges).

UNIT-IV ANALYTIC FUNCTIONS **9+3**

Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties – Harmonic conjugates – Construction of analytic function – Conformal mapping – Mapping by functions $w = z + c$, cz, $\frac{1}{z}$, z^2- Bilinear transformation.

UNIT-V COMPLEX INTEGRATION **9+3**

Line integral-Cauchy's integral theorem–Cauchy's integral formula–Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Applications of circular contour and semicircular contour (with poles not on real axis).

TOTAL: (L=45; T=15) 60 PERIODS

COURSE OUTCOMES

At the end of the course, the students will be able to:

CO1 Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.

CO2 Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.

CO3 Understand how to solve the given standard partial differential equations.
CO4 To develop an understanding of the standard techniques of complex variable theory in particular analytic function and its mapping property.
CO5 To acquaint the students with Differential Equations which are significantly used in engineering problems.

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, New Delhi, 2014.
2. Narayanan S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.

REFERENCES:

1. B.V Ramana, "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
2. Erwin Kreyszig, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, India, 2016.
3. G. James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.
4. L.C Andrews, L.C and Shivamoggi, B, "Integral Transforms for Engineers" SPIE Press, 1999.
5. Kreyszig.E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2	1	-	-	-	-	-	-	-	-	-	1	-
2	3	3	3	3	2	-	-	-	-	-	-	-	2	1
3	3	3	1	-	-	-	-	-	-	-	-	-	3	1
4	3	3	3	3	1	-	-	-	-	-	-	-	2	1
5	3	3	3	1	1	-	-	-	-	-	-	-	2	-
Avg.	3	3	2.2	1.5	1.1	0	0	0	0	0	0	0	2	1

1-low, 2-medium, 3-high, - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3351 **ENGINEERING MECHANICS**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamental principles of statics and particle equilibrium.
- To analyze rigid body systems under various force and moment conditions.
- To compute centroids, center of gravity, and moments of inertia for different geometries.
- To study the effect of friction and apply energy methods to particle motion.

- To apply dynamics concepts to analyze the motion of particles and rigid bodies.

UNIT-I STATICS OF PARTICLES **9**

Fundamental Concepts and Principles, Systems of Units, Method of Problem Solutions, Statics of Particles -Forces in a Plane, Resultant of Forces, Resolution of a Force into Components, Rectangular Components of a Force, Unit Vectors. Equilibrium of a Particle- Newton's First Law of Motion, Space and Free-Body Diagrams, Forces in Space, Equilibrium of a Particle in Space.

UNIT-II EQUILIBRIUM OF RIGID BODIES AND TRUSSES **9**

Principle of Transmissibility, Equivalent Forces, Vector Product of Two Vectors, Moment of a Force about a Point, Varignon's Theorem, Rectangular Components of the Moment of a Force, Scalar Product of Two Vectors, Mixed Triple Product of Three Vectors, Moment of a Force about an Axis, Couple - Moment of a Couple, Equivalent Couples, Addition of Couples, Resolution of a Given Force into a Force -Couple system, Further Reduction of a System of Forces, Equilibrium in Two and Three Dimensions - Reactions at Supports and Connections – Analysis of Trusses – Method of Joints and Method of Sections.

UNIT-III DISTRIBUTED FORCES **9**

Centroids of lines and areas – symmetrical and unsymmetrical shapes, Determination of Centroids by Integration, Theorems of Pappus - Guldinus, Distributed Loads on Beams, Centre of Gravity of a Three-Dimensional Body, Centroid of a Volume, Composite Bodies, Determination of Centroids of Volumes by Integration. Moments of Inertia of Areas and Mass - Determination of the Moment of Inertia of an Area by Integration, Polar Moment of Inertia, Radius of Gyration of an Area, Parallel-Axis Theorem, Moments of Inertia of Composite Areas, Moments of Inertia of a Mass - Moments of Inertia of Thin Plates, Determination of the Moment of Inertia of a Three-Dimensional Body by Integration.

UNIT-IV FRICTION AND PRINCIPLES OF FORCE **9**

The Laws of Dry Friction. Coefficients of Friction, Angles of Friction, Wedges, Wheel Friction. Rolling Resistance, Ladder friction. Work of a Force, Kinetic Energy of a Particle, Principle of Work and Energy, Principle of Impulse and Momentum, Impact, Method of Virtual Work - Work of a Force, Potential Energy, Potential Energy and Equilibrium.

UNIT-V DYNAMICS OF PARTICLES AND RIGID BODIES **9**

Kinematics - Rectilinear Motion and Curvilinear Motion of Particles. Kinetics- Newton's Second Law of Motion -Equations of Motions, Dynamic Equilibrium, Energy and Momentum Methods – Kinematics of Rigid Bodies and Plane Kinetics.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO 1: Apply principles of statics to solve problems involving particles and forces in space.

CO 2: Analyze forces, moments, and support reactions in rigid bodies and trusses.

CO 3: Determine centroids and moments of inertia for various 2D and 3D bodies.

CO 4: Evaluate the impact of friction and apply work-energy principles in mechanical systems.

CO 5: Solve dynamics problems involving particle motion using Newton's laws and energy methods.

TEXT BOOKS:

1. Beer Ferdinand P, Russel Johnston Jr., David F Mazurek, Philip J Cornwell, Sanjeev Sanghi, Vector Mechanics for Engineers: Statics and Dynamics, McGraw Higher Education., 12thEdition, 2019.

2. Vela Murali, “Engineering Mechanics-Statics and Dynamics”, Oxford University Press, 2018.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	3	-	-	-	-	-	-	-	-	3	-	-
2	3	3	2	3	-	-	-	-	-	-	-	-	3	-	-
3	3	3	2	3	-	-	-	-	-	-	-	-	3	-	-
4	3	3	2	3	-	-	-	-	-	-	-	-	3	-	-
5	3	3	2	3	-	-	-	-	-	-	-	-	3	-	-
Avg.	3	3	2	3	-	-	-	-	-	-	-	-	3	-	-

1-low, 2-medium, 3-high, - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3352 **ENGINEERING THERMODYNAMICS**

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

1.To impart knowledge on various forms of energy, energy transfer and energy interactions.

2.Impart knowledge on the second law of thermodynamics in analysing the performance of thermal devices

3.Teach the various properties of steam through steam tables and Mollier chart.

4.Impart knowledge on the macroscopic properties of ideal and real gases.

UNIT-I LAWS OF THERMODYNAMIC **9**

Thermodynamic systems, Properties and processes Thermodynamic Equilibrium - Displacement work - P-V diagram. Thermal equilibrium - Zeroth law – Concept of temperature and Temperature Scales. First law – application to closed and open systems – steady and unsteady flow processes, Second Law.

UNIT-II SECOND LAW AND CONCEPT OF ENTROPY **9**

Heat Engine – Refrigerator - Heat pump. Statements of second law and their equivalence & corollaries. Carnot cycle - Reversed Carnot cycle - Performance - Clausius inequality. Concept of entropy - T-s diagram - Tds Equations - Entropy change for a pure substance, Principle of increase in entropy.

UNIT-III EXERGY ANALYSIS **9**

High and low grade energy, Exergy and Anergy, Availability and Irreversibility for open and closed system processes - I and II law Efficiency, Applications of II Law.

UNIT-IV PROPERIES OF PURE SUBSTANCES, GAS MIXTURES **9**

Steam - formation and its thermodynamic properties - p-v, p-T, T-v, T-s, h-s diagrams. PVT

surface. Determination of dryness fraction of wet and very wet steam. Calculation of work done and heat transfer in non-flow and flow processes using Steam Table and Mollier Chart.

Properties of Ideal gas, real gas - comparison. Equations of state for ideal gas. Real Gas, Vander Waal's relation - Reduced properties - Compressibility factor

UNIT-V THERMODYNAMIC RELATIONS AND PSYCHROMETRY 9

Maxwell relations - Tds Equations - heat capacities relations - Energy equation, Joule-Thomson experiment - Clausius- Clapeyron equation.

Psychrometric properties, Psychrometric charts. Property calculations of air vapour mixtures by using chart and expressions. Psychrometric process

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Understand and carry out various thermodynamic system analysis

CO2: Apply the second law of thermodynamics to various thermal systems

CO3: Determine the availability and perform the exergy analysis of thermal systems

CO4: Evaluate the properties of pure substance and real gases

CO5: Explain the thermodynamic relations and compute properties of gas mixtures

TEXT BOOK:

1. Nag.P.K., "Engineering Thermodynamics", 6th Edition, Tata McGraw Hill (2017), New Delhi.
2. Natarajan, E., "Engineering Thermodynamics: Fundamentals and Applications", 2nd Edition (2014), Anuragam Publications, Chennai.

REFERENCE BOOK:

1. Cengel, Y and M. Boles, Thermodynamics - An Engineering Approach, Tata McGraw Hill,9th Edition, 2019.
2. Chattopadhyay, P, "Engineering Thermodynamics", 2nd Edition Oxford University Press, 2016.
3. Rathakrishnan, E., "Fundamentals of Engineering Thermodynamics", 2nd Edition, Prentice Hall of India Pvt. Ltd, 2006.
4. Claus Borgnakke and Richard E. Sonntag, "Fundamentals of Thermodynamics", 10th Edition, Wiley Eastern, 2019.
5. Venkatesh. A, "Basic Engineering Thermodynamics", Universities Press (India) Limited, 2007

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	3	2	1	-	-	1	-	-	-	-	1	2	1	2
2	2	3	2	1	-	-	1	-	-	-	-	1	3	1	2
3	2	3	2	1	1	-	1	-	-	-	-	1	3	2	2
4	2	3	2	1	-	1	-	-	-	-	-	1	2	2	2

5	2	3	2	1	-	1	-	-	-	-	-	1	2	1	2
Avg.	**2**	**3**	**2**	**1**	**1**	**1**	**1**	-	-	-	-	**1**	**2.4**	**1.4**	**2**

1-low, 2-medium, 3-high, - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3353 **MANUFACTURING TECHNOLOGY – I**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To illustrate the working principles of various metal casting processes.
- To learn and apply the working principles of various metal joining processes.
- To analyse the working principles of bulk deformation of metals.
- To learn the working principles of sheet metal forming process.
- To study and practice the working principles of plastics molding.

UNIT-I METAL CASTING PROCESSES **9**

Sand casting – Patterns: Types, allowances, materials, design – Moulding sand: Types, properties – Core making - Solidification & Cooling - Riser and gating design – Methods of sand testing – CO2 process - Melting furnaces.

Special casting processes – Shell, investment casting – Pressure die casting – Centrifugal casting – Casting defects – Inspection methods.

UNIT-II METAL JOINING PROCESSES **9**

Arc welding: Equipment – Electrodes – Coating and specifications – Gas metal arc welding – Submerged arc welding – Electro slag welding – Tungsten Inert Gas welding – Gas welding: Types – Equipment – Flame characteristics –- Resistance welding: Spot, butt, seam and percussion welding.

Special welding processes – Plasma arc welding – Thermit welding –Electron beam welding, Laser Beam Welding, Friction stir welding, Ultrasonic Welding – Weld defects – Brazing and soldering process –Filler materials and fluxes for all processes.

UNIT-III METAL FORMING PROCESSES **9**

Hot working and cold working of metals –Forging processes – Open, impression and closed die forging – Characteristics- Types of Forging Machines – Typical forging operations.

Rolling of metals – Types of Rolling mills - Flat strip rolling – Shape rolling– Defects in rolled parts- Wire and Rod - Tube drawing - Extrusion – Types - Equipment.

UNIT-IV SHEET METAL PROCESSES **9**

Sheet metal Characteristics - shearing, bending and drawing– Stretch forming – Formability of sheet metal - Bending force calculations – Test methods.

Working principle and applications of special forming processes - Hydro forming – Rubber pad forming – Metal spinning –Explosive forming - Magnetic pulse forming - Peen forming - Super plastic forming.

UNIT-V PROCESSING OF PLASTIC COMPONENTS **9**

Types of plastics - Characteristics of the forming and shaping processes – Moulding of Thermoplastics –Injection moulding – Plunger and screw machines – Compression moulding - Transfer moulding –Industrial applications –Blow moulding – Rotational moulding – Film blowing – Extrusion - Thermoforming - Bonding of Thermoplastics - Elastomers – Processing Reinforced plastics.

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO 1: Explain the principle of different metal casting processes.

CO 2: Describe the various metal joining processes.

CO 3: Illustrate the different bulk deformation processes.

CO 4: Apply the various sheet metal forming process.

CO 5: Apply suitable molding technique for manufacturing of plastics components.

TEXT BOOK:

1. Serope Kalpajian, Steven R.Schmid, “Manufacturing Engineering and Technology”, Pearson Education, Eighth Edition, 2020.

2. P.N. Rao, “Manufacturing Technology: Foundry, Forming and Welding - Volume 1”, Tata McGraw-Hill Publishing Limited, Fifth Edition, 2018.

REFERENCE BOOK:

1. P.C. Sharma, “A text book of Production Technology (Manufacturing Processes)”, S. Chand and Company, 8th Edition, 2022.

2.S.Gowri, P.Hariharan, and A.Suresh Babu, “Manufacturing Technology 1”, Pearson Education, 2020.

3. Hajra Choudhury, “Elements of Workshop Technology, Vol. I”, Media Promoters Pvt Ltd., Mumbai, Sixteenth reprint, 2017.

4. B.S. Nagendra Parashar & R.K. Mittal, “Elements of Manufacturing Processes”, Prentice Hall of India, 2011.

5. Beddoes.J and Bibby M.J, “Principles of Metal Manufacturing Processes”, Elsevier, 2006.

6. Rajput R.K, “A text book of Manufacturing Technology”, Lakshmi Publications, 2018.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	-	-	2	1	-	-	-	1	3	2	-
2	3	3	2	2	-	-	2	1	-	-	-	1	3	2	3
3	3	3	2	2	-	-	2	1	-	-	-	1	3	2	3
4	3	3	2	2	-	-	2	1	-	-	-	1	3	2	3
5	3	3	2	2	-	-	2	1	-	-	-	1	3	2	3
Avg.	**3**	**3**	**2**	**2**	-	-	**2**	**1**	-	-	-	**1**	**3**	**2**	**3**

1-low, 2-medium, 3-high, - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3354 ENGINEERING MATERIALS AND METALLURGY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To learn the constructing the phase diagram and using of iron-iron carbide phase diagram for microstructure formation.
- To learn selecting and applying various heat treatment processes and its microstructure formation.
- To illustrate the different types of ferrous and non-ferrous alloys and their uses in engineering field.
- To illustrate the different polymer, ceramics and composites and their uses in engineering field.
- To learn the various testing procedures and failure mechanism in engineering field.

UNIT-I ALLOYS AND PHASE DIAGRAMS 9

Constitution of alloys - Solid solutions, substitutional and interstitial - phase diagrams, Isomorphous, eutectic, eutectoid, peritectic, and peritectoid reactions, Iron - carbon equilibrium diagram. Classification of steel and cast Iron microstructure, properties and application.

UNIT-II HEAT TREATMENT 9

Definition – Full annealing, stress relief, recrystallisation and spheroidising – normalizing, hardening and tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on I.T. diagram – continuous cooling Transformation (CCT) diagram – Austempering, Martempering – Hardenability, Jominy end quench test -case hardening, carburizing, Nitriding, cyaniding, carbonitriding – Flame and Induction hardening – Vacuum and Plasma hardening – Thermo-mechanical treatments- elementary ideas on sintering.

UNIT-III FERROUS AND NON-FERROUS METALS 9

Effect of alloying additions on steel (Mn, Si, Cr, Mo, Ni, V,Ti& W) – stainless and tool steels – HSLA - Maraging steels – Grey, white, malleable, spheroidal – alloy cast irons, Copper and its alloys – Brass, Bronze and Cupronickel – Aluminium and its alloys; Al-Cu – precipitation strengthening treatment – Titanium alloys, Mg-alloys, Ni- based super alloys – shape memory alloys- Properties and Applications overview of materials standards

UNIT-IV NON-METALLIC MATERIALS 9

Polymers - types of polymer, commodity and engineering polymers - Properties and applications of various thermosetting and thermoplastic polymers (PP, PS, PVC, PMMA, PET, PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE, Polymers - Urea and Phenol formaldehydes)- Engineering

Ceramics - Properties and applications of Al2O3, SiC, Si3N4, PSZ and SIALON - Composites- Classifications- Metal Matrix and FRP - Applications of Composites.

UNIT-V TESTING OF MATERIALS **9**

Grain size determination by Microscopic techniques, Mechanical tests - tension, compression, impact, hardness, Fracture Toughness Test, Low & High Cycle Fatigues tests, Crack Growth studies – Creep Tests. Non Destructive Testing basic principles and testing methods for Radiographic testing, Ultrasonic testing, Magnetic Particle inspection and Liquid penetrant inspection test, Eddy current testing. Basics of X Ray Diffraction test-Bragg's law, Secondary Ion Mass Spectroscopy, Fourier Transform Infra-Red Spectroscopy (FTIR).

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO 1: Explain alloys and phase diagram, Iron-Iron carbon diagram and steel classification.

CO 2: Explain isothermal transformation, continuous cooling diagrams and different heat treatment processes.

CO 3: Clarify the effect of alloying elements on ferrous and non-ferrous metals.

CO 4: Summarize the properties and applications of non-metallic materials.

CO 5: Explain the testing of mechanical properties.

TEXT BOOK:

1. Williams D Callister, "Material Science and Engineering" Wiley India Pvt Ltd, Revised Indian Edition2014.
2. Raghavan.V, "Materials Science and Engineering", Prentice Hall of India Pvt.Ltd.,2015
3. O.P. Khanna, "Material Science and Metallurgy", DhanpatRai Publications, 2014

REFERENCE BOOK:

1. Avner, S.H., "Introduction to Physical Metallurgy", McGraw Hill Education; 2nd edition July 2017.
2. U.C.Jindal: Material Science and Metallurgy, "Engineering Materials and Metallurgy", First Edition, Dorling Kindersley,2012
3. Kenneth G.Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited,2010.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	-	1	-	-	-	-	-	1	2	1	2
2	3	2	3	2	-	-	2	-	-	-	-	2	2	1	2
3	3	-	2	-	-	1	-	-	-	-	-	2	2	1	2
4	3	-	2	2	-	1	-	-	-	-	-	3	2	1	2
5	3	3	2	1	-	-	-	-	-	-	-	2	2	1	2

Avg.	**3**	**2.7**	**2.2**	**1.8**	**-**	**1**	**2**	**-**	**-**	**-**	**-**	**2**	**2**	**1**	**2**

1-low, 2-medium, 3-high, - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3355 **FLUID MECHANICS AND MACHINERY**

L	T	P	C
3	0	2	4

COURSE OBJECTIVES:

- To introduce the students about properties of the fluids, behaviour of fluids under static conditions.
- To impart basic knowledge of the dynamics of fluids and boundary layer concept.
- To expose to the applications of the conservation laws to a) flow measurements b) flow through pipes (both laminar and turbulent) and c) forces on pipe bends.
- To exposure to the significance of boundary layer theory and its thicknesses.
- To expose the students to basic principles of working of hydraulic machineries and to design Pelton wheel, Francis and Kaplan turbine, centrifugal and reciprocating pumps.

UNIT-I FLUID PROPERTIES AND FLOW CHARACTERISTICS **15**

Definitions of fluid - Properties of fluids –Fluid pressure and its measurements – Forces on plane and curved surfaces - Buoyancy and floatation - Flow characteristics - Eulerian and Lagrangian Principle of fluid flow– concept of control volume and system – Continuity equation, energy equation and momentum equation - Applications.

PRACTICAL

1. Determination of the Coefficient of discharge of given Orifice meter.
2. Determination of the Coefficient of discharge of given Venturi meter
2. Determination of meta centric height

UNIT-II FLOW THROUGH PIPES AND BOUNDARY LAYER **15**

Reynold's Experiment- Laminar flow through circular conduits- Hagen Poiseuille equation -Darcy Weisbach equation – friction factor- Moody diagram- major and minor losses- Hydraulic gradient and total energy gradient – Pipes in series and parallel - Boundary layer concepts – types of boundary layer thickness.

PRACTICALS

1. Determination of friction factor for flow through pipes

UNIT-III DIMENSIONAL ANALYSIS AND MODEL STUDIES **15**

Fundamental dimensions - Dimensional homogeneity - Rayleigh's method and Buckingham Pi theorem - Dimensionless parameters - Similitude and model studies - Distorted and undistorted models.

UNIT-IV TURBINES **15**

Impact of jets - Velocity triangles - Theory of rotodynamic machines - Classification of turbines – Pelton wheel, Francis turbine and Kaplan turbine- Working principles - Work done by water on the runner - Efficiencies – Draft tube - Specific speed - Performance curves for turbines

PRACTICALS

1. Characteristics of Pelton wheel turbine,
2. Characteristics of Francis turbine
3. Characteristics of Kaplan turbine

UNIT-V PUMPS **15**

Classification of pumps- Centrifugal pumps – Working principle - Heads and efficiencies– Work done by the impeller - NPSH – Minimum speed to start the pump - Pumps connected in series and parallel - Performance curves - Reciprocating pump working principle – Indicator diagram and its variations – Air vessels - Work saved by air vessels.

PRACTICALS

1. Characteristics of centrifugal pumps
2. Characteristics of reciprocating pump & Gear Pump

TOTAL: (L=45; P=30) 75 PERIODS

COURSE OUTCOMES:

On completion of the course, the student is expected to be able to

CO 1: Understand the properties and behaviour in static conditions. Also, to understand the conservation laws applicable to fluids and its application through fluid kinematics and dynamics.

CO 2: Estimate losses in pipelines for both laminar and turbulent conditions and analysis of pipes connected in series and parallel. Also, to understand the concept of boundary layer and its thickness on the flat solid surface.

CO 3: Formulate the relationship among the parameters involved in the given fluid phenomenon and to predict the performances of prototype by model studies

CO 4: Explain the working principles of various turbines and design the various types of turbines.

CO 5: Explain the working principles of centrifugal, reciprocating and rotary pumps and design the centrifugal and reciprocating pumps

TEXT BOOK:

1. Modi P.N. and Seth S.M., Hydraulics and Fluid Mechanics including Hydraulics Machines, 22nd Ed., Standard Book House. New Delhi, 2019.
2. Jain A. K. Fluid Mechanics including Hydraulic Machines, Khanna Publishers, New Delhi, 2014.

REFERENCE BOOK:

1. Kumar K.L, Engineering Fluid Mechanics, (8th Ed.) S. Chand Publishing (India) Pvt. Ltd., New Delhi, 2016.
2. Som S.K. Gautam Biswas and Chakraborty S, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill Education Pvt. Ltd., 2017.
3. Subramanya, K. Fluid Mechanics and Hydraulic Machines,2nd Ed., Tata McGraw- Hill Pub.

Co., New Delhi, 2018.
4. Yunus A. Cengel ; John M. Cimbala, Fluid Mechanics,4th Ed., McGraw Hill Education Pvt. Ltd.,2019.
5. Streeter, V. L. and Wylie E. B., Fluid Mechanics, McGraw Hill Publishing Co.,1998.
6. Hydraulic Laboratory Manual, Centre for Water Resources, Anna University, 2023

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	1	1	1	2	1	1	1	2	3	2	2
2	3	3	3	1	1	1	1	2	1	1	1	2	3	3	3
3	3	3	3	2	1	1	1	2	1	1	1	2	3	3	2
4	3	3	3	2	1	1	1	3	1	1	1	3	3	3	3
5	**3**	**3**	**3**	**2**	**1**	**1**	**1**	**3**	**1**	**1**	**1**	**3**	**3**	**3**	**3**
Avg.	**3**	**3**	**3**	**2**	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**2**	**3**	**3**	**3**

1-low, 2-medium, 3-high, - no correlation

Note: The average value of this course to be used for program articulation matrix

24ME3312 **COMPUTER AIDED MACHINE DRAWING LABORATORY**

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

- To acquaint the skills and practical experience in handling 2D drafting and 3D modelling software
- systems, standard drawing practices using fits and tolerances.
- To prepare assembly drawings both manually and using standard CAD packages.
- To preparing standard drawing layout for modeled parts, assemblies with BoM.

PART I DRAWING STANDARDS & FITS AND TOLERANCES **12**

Code of practice for Engineering Drawing, BIS specifications – Welding symbols, riveted joints, keys, fasteners – Reference to hand book for the selection of standard components like bolts, nuts, screws, keys etc. - Limits, Fits – Tolerancing of individual dimensions IS919- Specification of Fits – Preparation of production drawings and reading of part and assembly drawings, basic principles of Geometric Dimensioning &Tolerancing.

PART II 2D DRAFTING **48**

Drawing, Editing, Dimensioning, Layering, Hatching, Block, Array, Detailing, Detailed Drawing.

1. Bearings – Bush Bearing,
2. Valves – Safety and Non-return Valves.
3. Couplings – Flange, Oldham's, Muff, Gear couplings.
4. Joints – Universal, Knuckle, Gib& Cotter, Strap, Sleeve & Cotter joints.
5. Engine parts – Piston, Connecting Rod, Crosshead (vertical and horizontal), Stuffing box, multi-plate clutch.
6. Machine Components – Screw Jack, Machine Vice, Lathe Tail Stock, Lathe Chuck, Plummer Block, Vane and Gear pumps.

Total: 20% of classes for theory classes and 80% of classes for practice

Note: 25% of assembly drawings must be done manually and remaining 75% of assembly drawings must be done by using any CAD software. The above tasks can be performed manually and using standard commercial 2D CAD software.

TOTAL:60 PERIODS

OUTCOMES:

At the end of the course the students would be able to

CO 1: Prepare standard drawing layout for modelled assemblies with BoM.

CO 2: Model orthogonal views of machine components.

CO 3: Prepare standard drawing layout for modelled parts

TEXT BOOKS:

1. Gopalakrishna K.R., "Machine Drawing", 17th Edition, Subhas Stores Books Corner, Bangalore,2003.

2. N. D. Bhatt and V.M. Panchal, "Machine Drawing", 51st Edition, Charator Publishers,2022.

REFERENCES:

1. K. L Narayana, P.Kannaiah, K.Venkata Reddy, Machine Drawing, 15 Edition, New Age International Publication

2. Goutam Pohit and Goutam Ghosh, "Machine Drawing with AutoCAD", 1st Edition, Pearson Education, 2004

3. Junnarkar, N.D., "Machine Drawing", 1st Edition, Pearson Education, 2004

4. N. Siddeshwar, P. Kanniah, V.V.S. Sastri," Machine Drawing", published by Tata McGrawHill,2006

5. S. Trymbaka Murthy, "A Text Book of Computer Aided Machine Drawing", CBS Publishers, New Delhi, 2007

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	2	-	-	3	-	-	-	3	2	-	3	2	2	2
2	1	2	-	-	3	-	-	-	3	2	-	3	2	2	2

3	1	2	-	-	3	-	-	-	3	2	-	3	2	2	2
Avg.	**1**	**2**	-	-	**3**	-	-	-	**3**	**2**	-	**3**	**2**	**2**	**2**

1-low, 2-medium, 3-high, - no correlation

Note: The average value of this course to be used for program articulation matrix

24ME3311 MANUFACTURING TECHNOLOGY LABORATORY – I

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

- To Selecting appropriate tools, equipment's and machines to complete a given job.
- To Performing various welding process using GMAW and fabricating gears using gear making machines.
- To Performing various machining process such as rolling, drawing, turning, shaping, drilling, milling and analysing the defects in the cast and machined components.

LIST OF EXPERIMENTS

1. Fabricating simple structural shapes using Gas Metal Arc Welding machine
2. Preparing green sand moulds with cast patterns
3. Taper Turning and Eccentric Turning on circular parts using lathe machine
4. Knurling, external and internal thread cutting on circular parts using lathe machine
5. Shaping – Square and Hexagonal Heads on circular parts using shaper machine
6. Drilling and Reaming using vertical drilling machine
7. Making a Frustum of Funnel.

TOTAL:60 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Demonstrate the safety precautions exercised in the mechanical workshop and join two metals using GMAW.

CO 2: The students able to make the work piece as per given shape and size using machining process such as rolling, drawing, turning, shaping, drilling and milling.

CO 3: The students become make the gears using gear making machines and analyze the defects in the cast and machined components

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3

1	3	-	-	-	-	-	1	-	2	-	-	1	1	2	2
2	3	-	-	-	-	-	1	-	2	-	-	1	1	2	2
3	3	-	-	-	-	-	1	-	2	-	-	1	1	2	2
Avg.	**3**	-	-	-	-	-	**1**	-	**2**	-	-	**1**	**1**	**2**	**2**

1-low, 2-medium, 3-high, - no correlation

Note: The average value of this course to be used for program articulation matrix

24TP3301 **SKILL ENHANCEMENT – III**

L	T	P	C
0	0	2	1

OBJECTIVE:

To educate and enrich the students on quantitative ability, reasoning ability, and verbal ability.

UNIT I QUANTITATIVE ABILITY – I 6

Problems on Trains - Time and Distance - Height and Distance - Time and Work.

UNIT II QUANTITATIVE ABILITY – II 6

Problems on Ages - Alligation or Mixture - Chain Rule - Simple Interest - Simple Equation - Theory of Equation.

UNIT III REASONING ABILITY – I 6

Analytical Reasoning - Pipes and Cistern - Logical Problems - Logical Games - Logical Deduction - Data Sufficiency - Arithmetic Reasoning.

UNIT IV VERBAL ABILITY – I 6

Idioms & Phrases - Synonyms - Antonyms - Classification.

UNIT V CREATIVITY ABILITY – I 6

Venn Diagrams, Cube and Cuboids, Dice, Cubes and Dice, Figure Matrix

TOTAL: 30 PERIODS

24ME3451 **THERMAL ENGINEERING**

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- To understand and analyze thermodynamic cycles used in power generation.
- To study steam nozzles and turbines with velocity diagrams and efficiency analysis.

- To learn the operation and performance of gas turbines and air compressors.
- To explore combustion processes and performance characteristics of IC engines.
- To evaluate IC engine performance and understand basic refrigeration systems.

UNIT-I THERMODYNAMIC CYCLES 12

Air Standard Cycles – Carnot, Otto, Diesel, Dual, Brayton – Cycle Analysis, Performance and Comparison, Rankine Cycle modified, reheat and regenerative cycles.

UNIT-II STEAM NOZZLES AND STEAM TURBINES 12

Steam Nozzles:

Types and Shapes of nozzles, Flow of steam through nozzles, Critical pressure ratio, Variation of mass flow rate with pressure ratio. Effect of friction. Metastable flow.

Steam Turbines:

Steam Turbine - Types, Impulse and reaction principles, Velocity diagrams, Work done and efficiency – optimal operating conditions. Multi-staging, compounding and governing.

UNIT-III GAS TURBINES & AIR COMPRESSOR 12

Gas Turbines:

Gas turbine cycle analysis – open and closed cycle. Performance and its improvement - Regenerative, Intercooled, Reheated cycles and their combination

Air Compressor:

Classification and working principle of various types of compressors, work of compression with and without clearance, Volumetric efficiency, Isothermal efficiency and Isentropic efficiency of reciprocating compressors

UNIT-IV INTERNAL COMBUSTION ENGINES – FEATURES AND COMBUSTION 12

Introduction to solid, liquid and gaseous fuels–Stoichiometry, IC engine – Classification, working, components and their functions. Ideal and actual: Valve and port timing diagrams, p-v diagrams-two stroke & four stroke, and SI & CI engines – comparison. Geometric, operating, and performance comparison of SI and CI engines.

Desirable properties and qualities of fuels. Air-fuel ratio calculation – lean and rich mixtures. Combustion in SI & CI Engines – Knocking – phenomena and control,

UNIT-V INTERNAL COMBUSTION ENGINE PERFORMANCE AND REFRIGERATION SYSTEM 12

Internal Combustion Engine Performance:

Performance and Emission Testing, Performance parameters and calculations. Morse and Heat Balance tests.

Refrigeration System:

Vapour compression refrigeration cycle, Effect of Superheat and Sub-cooling, Refrigerant types and properties, Performance calculations, vapour absorption system, and Thermoelectric refrigeration.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

CO 1: Analyze various thermodynamic cycles and assess their performance parameters.
CO 2: Evaluate steam nozzle flow characteristics and turbine efficiencies under different conditions.
CO 3: Explain the working principles and performance of gas turbines and compressors.
CO 4: Differentiate combustion phenomena in SI and CI engines and interpret engine performance charts.
CO 5: Calculate engine performance metrics and understand refrigeration cycle operations and efficiencies.

TEXT BOOK:

1. Mahesh. M. Rathore, "Thermal Engineering", 1st Edition, Tata McGraw Hill, 2010.
2. Ganesan.V, " Internal Combustion Engines" 4th Edition, Tata McGraw Hill, 2012.
3. Ballaney. P, "Thermal Engineering", 25th Edition, Khanna Publishers, 2017

REFERENCE BOOK:

1. Ananthanarayanan P.N, "Basic Refrigeration and Air-Conditioning", 4th Edition, Tata McGraw Hill, 2013.
2. Domkundwar, Kothandaraman, & Domkundwar, "A Course in Thermal Engineering", 6th Edition, Dhanpat Rai& Sons, 2011.
3. Gupta H.N, "Fundamentals of Internal Combustion Engines", 2nd Edition Prentice Hall of India, 2013
4. Nag P.K, "Basic and Applied Thermodynamics", 2nd Edition, Tata McGraw Hill, 2010
5. Soman. K, "Thermal Engineering", 2nd Edition, Prentice Hall of India, 2011

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	2	2	-	-	-	-	-	-	1	2	2	1
2	3	2	2	2	2	-	-	-	-	-	-	1	2	2	1
3	3	2	2	2	2	-	-	-	-	-	-	1	2	2	1
4	3	2	2	2	2	-	-	-	-	-	-	1	2	2	1
5	3	2	2	2	2	-	-	-	-	-	-	1	2	2	1
Avg.	**3**	**2**	**2**	**2**	**2**	-	-	-	-	-	-	**1**	**2**	**2**	**1**

1-low, 2-medium, 3-high, - no correlation

Note: The average value of this course to be used for program articulation matrix

24ME3452 **FLUID POWER AUTOMATION**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To provide the knowledge on the working principles of fluid power systems.
- To study the fluids and components used in modern industrial fluid power system.
- To develop the design, construction and operation of fluid power circuits.
- To learn the working principles of pneumatic power system and its components.
- To provide the knowledge of trouble shooting methods in fluid power systems.

UNIT-I FLUID POWER PRINICIPLES AND HYDRAULIC PUMPS 9

Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids – Properties of fluids and selection – Basics of Hydraulics – Pascal's Law – Principles of flow – Friction loss – Work, Power and Torque- Problems, Sources of Hydraulic power : Pumping Theory – Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of pumps – Fixed and Variable displacement pumps – Problems.

UNIT-II HYDRAULIC ACTUATORS AND CONTROL COMPONENTS 9

Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Rotary Actuators – Hydraulic motors - Control components: Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Accessories: Accumulators, Pressure Intensifiers, Reservoirs, Pressure Switches – Filters –types and selection- Applications – Fluid Power ANSI Symbols – Problems.

UNIT-III HYDRAULIC CIRCUITS AND SYSTEMS 9

Industrial hydraulic circuits – Regenerative, Pump Unloading, Double Pump, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Deceleration circuits, Sizing of hydraulic systems, Hydrostatic transmission, Electro hydraulic circuits – Servo and Proportional valves – Applications – Mechanical, hydraulic servo systems, **Case Studies.**

UNIT-IV PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS 9

Properties of air – Air preparation and distribution – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit – classification single cylinder and multi cylinder circuits – Cascade method – Integration of fringe circuits, Electro Pneumatic System – Elements – Relay ladder diagram – timer circuits – Problems, PLC – Logic ladder diagram – Controlling Fluid power actuators, Case Studies.

UNIT-V TROUBLE SHOOTING AND APPLICATIONS 9

Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Conditioning of hydraulic fluids Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications. Design of Pneumatic circuits for metal working, handling, clamping counter and timer circuits – Low cost Automation – Hydraulic and Pneumatic power packs, Case Studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO 1: Explain fluid power principles and analyze the performance and selection of hydraulic pumps.

CO 2: Describe various hydraulic actuators, control valves, and accessories with their applications.

CO 3: Design and evaluate industrial hydraulic circuits and apply electro-hydraulic systems in automation.

CO 4: Construct pneumatic and electro-pneumatic circuits using logical control and PLC-based methods.

CO 5: Diagnose faults and design fluid power systems for industrial and low-cost automation applications.

TEXT BOOK:

1. Anthony Esposito, "Fluid Power with Applications", Prentice Hall, 2009.
2. James A. Sullivan, "Fluid Power Theory and Applications", Prentice Hall, 1997.

REFERENCE BOOK:

1. Shanmugasundaram.K., "Hydraulic and Pneumatic Controls". Chand & Co, 2006.
2. Jagadeesha. T., "Pneumatics Concepts, Design and Applications ", Universities Press, 2015.
3. Joshi.P., Pneumatic Control", Wiley India, 2008.
4. Srinivasan.R., "Hydraulic and Pneumatic Controls", Vijay Nicole Imprints, 2008.
5. Majumdar, S.R., "Oil Hydraulics Systems – Principles and Maintenance", Tata McGraw Hill, 2001.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	1	1	-	-	-	-	-	-	-	1	3	1	3
2	3	1	1	1	-	-	-	-	-	-	-	1	3	1	3
3	3	3	3	3	-	-	-	-	-	-	-	1	3	1	3
4	3	3	3	3	-	-	-	-	-	-	-	1	3	1	3
Avg.	**3**	**2.6**	**2.6**	**2.6**	-	-	-	-	-	-	-	**1**	**3**	**1**	**3**

1-low, 2-medium, 3-high, - no correlation

Note: The average value of this course to be used for program articulation matrix

24ME3453 **MANUFACTURING TECHNOLOGY – II**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of metal cutting mechanics and tool materials.
- To explore operations and mechanisms of lathes and special-purpose turning machines.
- To study the working principles of reciprocating and milling machines, and hole-making tools.
- To learn gear manufacturing techniques and surface finishing processes.
- To introduce CNC machines, their components, and the basics of part programming.

UNIT-I FUNDAMENTALS OF MACHINING **9**

Introduction: Material removal processes, types of machine tools – Metal cutting theory: Mechanics of metal cutting, chip formation, orthogonal and oblique cutting, shear zones, Merchants circle, Single point cutting tool geometry, cutting tool materials, tool wear, tool life, surface finish, cutting fluids - Influence of tool angles - Influence of tool height

UNIT-II CENTRE LATHE AND SPECIAL PURPOSE LATHES **9**

Centre lathe, constructional features, various operations - taper turning methods, thread cutting methods, special attachments, machining time and power estimation.
Capstan and turret lathes – Automats – Single spindle, Swiss type, multi spindle - Turret Indexing mechanism, Bar feed mechanism

UNIT-III MACHINE TOOLS FOR NON-CIRCULAR COMPONENTS AND HOLE MAKING 9

Reciprocating machine tools: shaper, planer, slotter (Construction details only). Milling machines: Horizontal milling m/c and Vertical milling m/c: specifications, parts, milling cutters, work holding devices, operations. Hole making: Drilling, reaming, boring, tapping - sawing machine: hack saw, band saw, circular saw; broaching machines: Push, pull, surface and continuous broaching machines – broach construction

UNIT-IV GEAR MANUFACTURING AND SURFACE FINISHING PROCESSES 9

Gear manufacturing processes: Extrusion, Stamping and Powder metallurgy. Gear machining: Forming, Gear generating process – Gear shaping, Gear hobbing. Surface finishing- Abrasive processes: Types of grinding process – cylindrical grinding, surface grinding, centre less grinding – grinding wheel specifications and selection. Fine finishing processes – Honing, lapping, super finishing, polishing and buffing, power brushing-Tumbling - Metal spraying – Metallization.

UNIT-V CNC MACHINE TOOLS AND PART PROGRAMMING 9

Numerical control (NC) machine tools - CNC: types, constructional details, special features – Design considerations of CNC machines for improving machining accuracy -(Structural members, Slide ways, Linear bearings, Ball screws, Spindle drives and feed drives) - Part programming fundamentals – Manual programming – Basic NC programs (introductory programs only) - Post processors.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO 1: Analyze chip formation, tool geometry, and tool wear in metal cutting processes.
CO 2: Operate and estimate machining time for various lathe and turret lathe operations.
CO 3: Explain the construction and applications of shapers, milling machines, and broaching tools.
CO 4: Differentiate gear manufacturing methods and apply surface finishing processes appropriately.
CO5: Demonstrate basic CNC part programming and understand CNC machine tool design features.

TEXT BOOK:

1. Rao, P.N. “Manufacturing Technology”, Metal Cutting and Machine Tools, 3rd edition Tata McGraw– Hill, New Delhi, 2018.
2. Raghuvanshi. B.S, “A course in Workshop Technology – Vol II”. 10th Revised Edition, Dhanpat Rai& Co., 2018.

REFERENCE BOOK:

1. Hajra Choudry, “Elements of Workshop Technology: Machine Tools (Volume - 2)”, Media Promoters, 2010.
2. P.C. Sharma, “A text book of Production Technology (Manufacturing Processes) 7th Edition”, S. Chand and Company, 2008.
3. Rajput R.K, ‘A text book of Manufacturing Technology’, 3rd edition Lakshmi Publications, 2023.
4. Philip F.Ostwald and Jairo Munoz, ‘Manufacturing Processes and systems’, John Wiley and Sons, 9th Edition, 2008.
5. MikellP.Groover, ‘Fundamentals of Modern Manufacturing, Materials, Processes and Systems’, John Wiley and Sons, 7th Edition, 2019.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	3	3	2	2	2	-	-	-	2	3	3	1
2	3	3	2	3	-	-	-	-	-	-	-	-	3	2	-
3	3	3	2	3	-	-	-	-	-	-	-	-	3	1	-
4	3	3	2	3	2	-	-	-	-	-	-	-	3	3	-
5	3	3	3	3	3	-	-	-	-	-	-	2	3	3	1
Avg.	**3**	**3**	**2.2**	**3**	**2.7**	**2**	**2**	**2**	-	-	-	**2**	**3**	**2.4**	**1**

1-low, 2-medium, 3-high, - no correlation

Note: The average value of this course to be used for program articulation matrix

24ME3456 **MECHANICS OF MATERIALS**

L	T	P	C
3	0	2	4

COURSE OBJECTIVES:

- To introduce the fundamental concepts of stress, strain, and deformation in solids.
- To analyze shear force, bending moment, and stresses in various beam configurations.
- To understand torsion in shafts and springs with practical application.
- To compute beam deflection using various methods and the concept of strain energy.
- To study stresses in shells, thick cylinders, and apply failure and buckling theories.

UNIT-I STRESS, STRAIN AND DEFORMATION OF SOLIDS **15**

Rigid bodies and deformable solids –Stresses and strains: Tension, Compression and Shear - Elastic constants – Relationships – Compound bars – Thermal stresses –Volumetric strains – Stress on inclined planes – Principal stresses and principal planes – Mohr’s circle of stress.

PRACTICALS

1. Tension test on mild steel rod

UNIT-II TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM 15

Beams – Types - Transverse loading on beams – Shear force and bending moment in beams – Cantilevers – Simply supported beams and over hanging beams - Theory of simple bending – Bending stress distribution - Load carrying capacity - Proportioning of sections –Fletched beams –Carriage springs – Shear stress distribution- Shear Centre.

PRACTICALS

1. Deflection test on carriage spring

UNIT-III TORSION 15

Theory of Pure Torsion- Stresses and deformation in circular and hollows shafts – Transmission of power through hollow & solid shafts – Stepped shafts –Shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs.

PRACTICALS

1. Torsion test on mild steel rod

UNIT-IV DEFLECTION OF BEAMS 15

Double Integration method – Macaulay's method – Area moment method - Conjugate beam method - Strain energy method - computation of slopes and deflections in beams- Maxwell's reciprocal theorem.

PRACTICALS

1. Compression test on helical spring

UNIT-V THIN &THICK SHELLS, THEORIES OF FAILURE 15

Stresses and deformations in thin cylindrical shells and spherical shells subjected to internal pressure – Stresses in thick cylinders – Lame's theory – Application of theories of failure- Euler's buckling theory.

PRACTICALS

1. Hardness test on metal beam (Rockwell and Brinell hardness test)

TOTAL: (L=45; P=30) 75 PERIODS

COURSE OUTCOMES:

CO 1: Calculate stresses, strains, and use Mohr's circle to determine principal planes and stresses.

CO 2: Determine shear force and bending moment diagrams and compute stresses in beams.

CO 3: Analyze torsional stress and deformation in solid and hollow shafts and springs.

CO 4: Apply analytical methods to compute beam deflections and slopes under various loads.

CO 5: Evaluate stresses in thin/thick shells and use failure theories for design safety assessment.

TEXT BOOKS:

1. Bansal, R.K., Strength of Materials, Laxmi Publications (P) Ltd., 2018
2. Rajput, R.K., Strength of Materials, S Chand and Company Ltd., New Delhi, 2018

REFERENCE BOOK:

1. Strength of Materials Laboratory Manual, Anna University, Chennai - 600025.
2. IS 432 (art I) -1992, Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement.
3. Egor. P.Popov "Engineering Mechanics of Solids" Prentice Hall of India, New Delhi, 2015.
4. Ferdinand P. Beer, Russell Johnson, Jr. and John J. Dewole Mechanics of Materials, 7 th Edition, Tata McGraw Hill publishing 'co. Ltd., New Delhi, 2014.
5. Hibbeler, R.C., Mechanics of Materials, Pearson Education, 10th Edition, 2022.
6. Subramanian R., Strength of Materials, Oxford University Press, Oxford Higher Education Series, 2007

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	3	2	2	2	3	3	1	1	2	3	3	2
2	3	3	3	3	2	3	2	3	1	1	1	2	3	2	2
3	3	3	3	3	2	3	2	3	3	1	1	2	3	3	2
4	3	3	3	3	2	2	2	2	3	1	1	2	3	2	2
5	3	3	3	3	2	3	2	3	1	1	1	2	3	3	2
Avg.	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**1**	**1**	**2**	**3**	**3**	**2**

1-low, 2-medium, 3-high, - no correlation

Note: The average value of this course to be used for program articulation matrix

24ME3455 KINEMATICS AND DYNAMICS OF MACHINERY

L	T	P	C
3	0	2	4

COURSE OBJECTIVES:

- To study the fundamentals of kinematic mechanisms and cam profile generation.
- To understand the principles of gear geometry, gear trains, and their applications.
- To analyze the role of friction in machine elements and power transmission devices.
- To perform static and dynamic force analysis in mechanical systems using graphical and analytical methods.
- To understand the balancing of rotating systems and analyze different types of mechanical vibrations.

UNIT-I KINEMATIC ANALYSIS IN SIMPLE MECHANISMS AND CAMS 15

Mechanisms – Terminology and definitions – kinematics inversions and analysis of 4 bar and slide crank chain – velocity and acceleration polygons – Cams – classifications – displacement diagrams-layout of plate cam profiles.

PRACTICALS

1. Cams – Cam profile drawing and Motion curves

UNIT-II TOOTHED GEARING AND GEAR TRAINS 15

Gear terminology – law of toothed gearing – involute gearing – Gear tooth action - Interference and undercutting – gear trains – parallel axis gear trains – epicyclic gear trains.

PRACTICALS

1. Study of gear parameters: Experimental study of velocity ratios of simple, compound, epicyclic and differential gear trains.

UNIT-III FRICTION ASPECTS IN MACHINE COMPONENTS 15

Surface contacts – Sliding and Rolling friction – Friction drives – Friction in screw threads – Friction clutches – Belt drives – Friction aspects in brake

UNIT-IV STATIC AND DYNAMIC FORCE ANALYSIS 15

Applied and Constrained Forces – Free body diagrams – Static equilibrium conditions – Static Force analysis in simple mechanisms – Dynamic Force Analysis in simple machine members – Inertia Forces and Inertia Torque – D'Alembert's principle

UNIT V BALANCING OF ROTATING MASSES AND VIBRATION 15

Static and Dynamic balancing – Balancing of revolving masses – Balancing machines – Free vibrations – natural Frequency – Damped Vibration – Critical speed of simple shafts – Forced vibration – Harmonic forcing – Vibration isolation.

TOTAL: (L=45; P=30) 75 PERIODS

COURSE OUTCOMES:

CO 1: Analyze simple mechanisms and construct cam profiles using displacement diagrams.
CO 2: Demonstrate understanding of gear tooth action, gear trains, and calculate velocity ratios.
CO 3: Evaluate friction in mechanical components like belts, clutches, and brakes.
CO 4: Apply principles of static and dynamic force analysis for various machine parts.
CO 5: Analyze vibrations in mechanical systems and understand balancing techniques for rotating bodies.

TEXT BOOKS

1. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", Oxford University Press, 2017.

REFERENCE BOOKS

1. Cleghorn. W. L., Nikolai Dechev, "Mechanisms of Machines", Oxford University Press, 2015.
2. Rao.J.S. and Dukkipati.R.V. "Mechanism and Machine Theory", New Age International Pvt. Ltd., 2006.
3. Rattan, S.S, "Theory of Machines", McGraw-Hill Education Pvt. Ltd., 2014
4. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw-Hill, 2017.

5. Thomas Bevan, “The Theory of Machines”, Pearson Education Ltd., 2010.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	3	2	2	2	3	1	1	1	2	3	1	-
2	3	3	3	3	2	3	2	3	1	1	1	2	3	1	-
3	3	3	3	3	2	3	2	3	1	1	1	2	3	1	-
4	3	3	3	3	2	2	2	2	1	1	1	2	3	1	-
5	3	3	3	3	2	2	2	2	1	1	1	2	3	1	-
Avg.	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2.6**	**1**	**1**	**1**	**2**	**3**	**1**	-

1-low, 2-medium, 3-high, - no correlation

Note: The average value of this course to be used for program articulation matrix

24ME3454 **PRODUCT DESIGN AND DEVELOPMENT**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the integrated approach to product development and the strategic importance of customer-centric design.
- To explore structured methods for idea generation, including TRIZ and concept evaluation techniques.
- To learn how product architecture affects performance, standardization, and product change management.
- To comprehend the role of industrial design in enhancing functionality, aesthetics, and manufacturability.
- To apply principles of design for manufacturing, prototyping, and economic analysis in product development.

UNIT-I INTRODUCTION TO PRODUCT DESIGN **9**

Need for IPPD – Strategic importance of Product development – integration of customer, designer, material supplier and process planner, Competitor and customer – Behaviour analysis. Understanding customer – prompting customer understanding – involve customer in development and managing requirements – Organization – process management and improvement – Plan and establish product specifications Processes and Organizations: The AMF development process, product development organizations, the AMF organization.

UNIT-II CONCEPT GENERATION **9**

Task – Structured approaches – clarification – search – externally and internally – explore

systematically – reflect on the solutions and processes – concept selection – methodology – benefits TRIZ and its comparison with brainstorming and lateral thinking, TRIZ tools Ideality and IFR

UNIT-III PRODUCT ARCHITECTURE 9

Implications – Product change – variety – component standardization – product performance – manufacturability – product development management – establishing the architecture – creation – clustering – geometric layout development – fundamental and incidental interactions – related system level design issues – secondary systems – architecture of the chunks – creating detailed interface specifications.

UNIT-IV INDUSTRIAL DESIGN 9

Integrate process design – Managing costs – Robust design – Integrating CAE, CAD, CAM tools – Simulating product performance and manufacturing processes electronically – Need for industrial design – impact – design process – investigation of for industrial design – impact – design process – investigation of customer needs – conceptualization – refinement – management of the industrial design process – technology driven products – user – driven products – assessing the quality of industrial design

UNIT-V DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT 9

Definition – Estimation of Manufacturing cost – reducing the component costs and assembly costs – Minimize system complexity – Prototype basics – principles of prototyping – planning for prototypes – Economic Analysis – Understanding and representing tasks – baseline project planning – accelerating the project – project execution

COURSE OUTCOMES:

CO 1: Identify the roles of stakeholders and processes in integrated product and process development.

CO 2: Generate, evaluate, and select product concepts using systematic methods like TRIZ.

CO 3: Develop effective product architecture for performance, modularity, and ease of manufacture.

CO 4: Integrate industrial design with engineering tools to enhance product quality and user satisfaction.

CO 5: Apply DFM principles and evaluate prototyping and project planning for efficient product realization.

TEXT BOOK:

1. Kari T.Ulrich and Steven D.Eppinger, ”Product Design and Development”, McGraw-Hill International Edns. 1999.
2. A K Chitale and R C Gupta, Product Design and Manufacturing, 6th Edition, PHI, New Delhi, 2003

REFERENCE BOOK:

1. George E Deiter, Engineering Design, 5th Edition, McGraw-Hill, 2012
2. Kemnneth Crow, “Concurrent Engg./Integrated Product Development”, DRM Associates,

26/3,Via Olivera, Palos Verdes, CA 90274(310) 377-569, Workshop Book
3. Boothroyd G, Dewhurst P and Knight W, Product Design for Manufacture and Assembly, 2nd Edition, Marcel Dekker, New York, 2002

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2
2	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2
3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2
4	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2
5	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2
Avg.	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**

1-low, 2-medium, 3-high, - no correlation

Note: The average value of this course to be used for program articulation matrix

24ME3411 THERMAL ENGINEERING LABORATORY

L	T	P	C
0	0	4	2

COURSE OBJECTIVES

1. To study the valve and port timing diagram and performance characteristics of IC engines
2. To study the Performance of refrigeration cycle / components
3. To study the Performance and Energy Balance Test on a Steam Generator.

PART I IC ENGINES LABORATORY **45**

List of Experiments

1. Valve Timing and Port Timing diagrams.
2. Actual p-v diagrams of IC engines.
3. Performance Test on four – stroke Diesel Engine.
4. Heat Balance Test on 4 – stroke Diesel Engine.
5. Morse Test on Multi-Cylinder Petrol Engine.
6. Retardation Test on a Diesel Engine.
7. Determination of p-θ diagram and heat release characteristics of an IC engine.
8. Determination of Flash Point and Fire Point of various fuels / lubricants
9. Performance test on a two stage Reciprocating Air compressor
10. Determination of COP of a Refrigeration system

PART II STEAM LABORATORY **15**

List of Experiments:

1. Study of Steam Generators and Turbines.
2. Performance and Energy Balance Test on a Steam Generator.
3. Performance and Energy Balance Test on Steam Turbine.

TOTAL:60 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO 1: Conduct tests to evaluate performance characteristics of IC engines

CO 2: Conduct tests to evaluate the performance of refrigeration cycle

CO 3: Conduct tests to evaluate Performance and Energy Balance on a Steam Generator.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	1	1	-	-	-	-	1	-	-	1	1	1	1
2	2	2	1	1	-	-	-	-	1	-	-	1	1	1	1
3	2	2	1	1	-	-	-	-	1	-	-	1	1	1	1
Avg.	2	2	1	1	-	-	-	-	1	-	-	1	1	1	1

1-low, 2-medium, 3-high, - no correlation

Note: The average value of this course to be used for program articulation matrix

24ME3412 **MANUFACTURING TECHNOLOGY LABORATORY - II**

L	T	P	C
0	0	4	2

LIST OF EXPERIMENTS:

1. Contour milling using vertical milling machine
2. Spur gear cutting in milling machine
3. Helical Gear Cutting in milling machine
4. Gear generation in hobbing machine
5. Gear generation in gear shaping machine
6. Plain Surface grinding
7. Cylindrical grinding
8. Tool angle grinding with tool and Cutter Grinder
9. Measurement of cutting forces in Milling / Turning Process
10. CNC Part Programming

TOTAL:60 PERIODS

COURSE OUTCOMES:

CO 1: Demonstrate the ability to perform contour milling and gear cutting operations using milling machines.

CO 2: Analyze and interpret cutting forces during milling and turning using dynamometers.

CO 3: Develop basic CNC part programs and understand gear generation using shaping and hobbing machines.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3	2	3	-	-	-	2	2	-	-	3	2	-
2	3	3	2	3	3	-	-	-	2	2	-	-	3	2	-
3	3	2	3	2	3	-	-	-	2	2	-	-	3	3	-
Avg.	3	2.3	2.6	2.3	3	-	-	-	2	2	-	-	3	2.3	-

1-low, 2-medium, 3-high, - no correlation

Note: The average value of this course to be used for program articulation matrix

24TP3401 **SKILL ENHANCEMENT – IV**

L	T	P	C
0	0	2	1

COURSE OBJECTIVE:

- Improve their quantitative ability.
- Improve their reasoning ability.
- Enhance their verbal ability through vocabulary building and grammar.
- Equip with creative thinking and problem solving skills.

UNIT I QUANTITATIVE ABILITY – III **6**

Compound Interest - Proit and Loss - Partnership - Percentage - Set Theory

UNIT II QUANTITATIVE ABILITY – IV **6**

True Discount - Ratio and Proportion - Simpliication - Problems on H.C.F and L.C.M

UNIT III REASONING ABILITY – II **6**

Course of Action - Cause and Effect - Statement and Conclusion - Statement and Argument - Data Suficiency (DS) - Statement and Assumption - Making Assumptions.

UNIT IV VERBAL ABILITY – II **6**

Change of Voice - Change of Speech - Letter and Symbol Series - Essential Part - Verbal Reasoning - Analyzing Arguments.

UNIT V CREATIVITY ABILITY – II **6**

Seating Arrangement - Direction Sense Test - Character Puzzles – Missing

TOTAL: 30 PERIODS

24ME3551 DESIGN OF MACHINE ELEMENTS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. To apply the systematic steps of the engineering design process to solve mechanical component design problems.
2. To design shafts and couplings to meet functional and safety requirements for various engineering applications.
3. To design and select appropriate temporary and permanent joints based on loading, material, and service conditions.
4. To design helical springs, leaf springs, and flywheels for specific operational and performance requirements.
5. To select, design, and justify suitable sliding and rolling contact bearings, seals, and gaskets for mechanical systems.

(Use of PSG Design Data book is permitted)

UNIT I FUNDAMENTAL CONCEPTS IN DESIGN 9

Introduction to the design process - factors influencing machine design, selection of materials based on mechanical properties - Preferred numbers- Direct, Bending, and torsional loading- Modes of failure - Factor of safety – Combined loads – Principal stresses -Eccentric loading - curved beams – crane hook and ‘C’ frame- theories of failure – Design based on strength and stiffness – stress concentration – Fluctuating stresses – Endurance limit –Design for finite and infinite life under variable loading - Exposure to standards.

UNIT II DESIGN OF SHAFTS AND COUPLINGS 9

Shafts - Design of solid and hollow shafts based on strength and rigidity and critical speeds – Rigid and flexible couplings.

UNIT III DESIGN OF TEMPORARY AND PERMANENT JOINTS 9

Threaded fasteners - Bolted joints including eccentric loading, knuckle joints- welded joints butt, fillet and parallel transverse fillet welds– welded joints subjected to bending and torsional and eccentric loads, riveted joints for structures.

UNIT IV DESIGN OF ENERGY STORING ELEMENTS 9

Types of springs, design of helical and concentric springs–Surge in springs, Design of laminated springs. Flywheels considering stresses in rims and arms for engines and punching machines.

UNIT V DESIGN OF BEARINGS AND MISCELLANEOUS ELEMENTS 9

Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, Sommerfeld Number, Raimondi & Boyd graphs - Selection of Rolling Contact bearings – Design of Seals and Gaskets.

TOTAL: 45 PERIODS

COURSE OUTCOMES

At the end of the course, the student should be able to

1. Apply the systematic steps of machine members subjected to static and variable loading conditions.
2. Design and analyze shafts, keys, and couplings to satisfy strength, stiffness, and safety requirements.
3. Design and assess bolted, knuckle, riveted, and welded joints based on load and service conditions.
4. Design and analyze helical springs, leaf springs, and flywheels for specific functional applications.
5. Select, design, and justify sliding and rolling contact bearings and seals for mechanical systems.

TEXT BOOKS

1. Bhandari V B, "Design of Machine Elements", 5th Edition, Tata McGraw-Hill Book Co, 2020
2. Joseph Shigley, Richard G. Budynas and J. Keith Nisbett "Mechanical Engineering Design" 11th Edition, Tata McGraw-Hill, 2020.

REFERENCES

1. Ansel C Ugural, "Mechanical Design – An Integral Approach", 1st Edition, Tata McGraw- Hill Book Co, 2003.
2. Design Data Hand Book", PSG College of Technology, Coimbatore, 2023.
3. Merhyle Franklin Spotts, Terry E. Shoup, and Lee Emrey Hornberger, "Design of Machine Elements" 8th Edition, Printice Hall, 2019.
4. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine Component Design",7th Edition, Wiley, 2020.
5. Sundararajamoorthy T. V. and Shanmugam. N, "Machine Design", Anuradha Publications, Chennai, 2018.
6. Khurmi R. S. and Gupta J. K, "Machine Design", 25th Edition, S Chand, New Delhi,2020.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	1	-	-	-	-	3	3	3	2	2
CO2	3	3	3	3	2	1	-	-	-	-	2	2	3	2	2
CO3	3	3	3	3	2	1	-	-	-	-	3	3	3	2	2

CO4	3	3	3	3	2	1	-	-	-	-	3	3	3	2	2
CO5	3	3	3	3	2	1	-	-	-	-	3	3	3	2	2
Avg.	**3**	**3**	**3**	**3**	**2**	**1**	-	-	-	-	**3**	**3**	**3**	2	2

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix

24IC3401 ENGINEERING ENTREPRENEURSHIP DEVELOPMENT

L	T	P	C
2	**0**	**2**	**3**

COURSE OBJECTIVES

1. Apply basic concepts of entrepreneurship to develop an entrepreneurial mindset and demonstrate the skills required to identify and explore entrepreneurial opportunities.
2. Apply process of problem - opportunity identification and validation through human centered approach to design thinking in building solutions as part of engineering projects
3. Analyse market types, conduct market estimation, identify customers, create customer persona, develop the skills to create a compelling value proposition and build a Minimum Viable Product
4. Explore business models, create business plan, conduct financial analysis and feasibility analysis to assess the financial viability of a venture ideas & solutions built with domain expertise
5. Prepare and present an investible pitch deck of their practice venture to attract stakeholders

UNIT I ENTREPRENEURIAL MINDSET 12

Introduction to Entrepreneurship: Definition – Types of Entrepreneurs – Emerging Economies, Developing and Understanding an Entrepreneurial Mindset – Importance of Technology Entrepreneurship – Benefits to the Society.

Case Analysis: Study cases of successful & failed engineering entrepreneurs - Foster Creative Thinking: Engage in a series of Problem-Identification and Problem-Solving tasks

UNIT II OPPORTUNITIES 12

Problems and Opportunities – Ideas and Opportunities – Identifying problems in society Creation of opportunities – Exploring Market Types – Estimating the Market Size- Knowing the Customer and Consumer - Customer Segmentation - Identifying niche markets – Customer discovery and validation; Market research techniques, tools for validation of ideas and opportunities

Activity Session: Identify emerging sectors / potential opportunities in existing markets - Customer Interviews: Conduct preliminary interviews with potential customers for Opportunity Validation - Analyse feedback to refine the opportunity.

UNIT III PROTOTYPING & ITERATION 12

Prototyping – Importance in entrepreneurial process – Types of Prototypes - Different methods – Tools & Techniques.

Hands-on sessions on prototyping tools (3D printing, electronics, software), Develop a prototype based on identified opportunities; Receive feedback and iterate on the proto- types.

UNIT IV BUSINESS MODELS & PITCHING 12

Business Model and Types - Lean Approach - 9 block Lean Canvas Model - Riskiest Assumptions in Business Model Design – Using Business Model Canvas as a Tool – Pitching Techniques: Importance of pitching - Types of pitches - crafting a compelling pitch – pitch presentation skills - using storytelling to gain investor/customer attention.

Activity Session: Develop a business model canvas for the prototype; present and receive feedback from peers and mentors - Prepare and practice pitching the business ideas- Participate in a Pitching Competition and present to a panel of judges - receive & reflect feedback

UNIT V ENTREPRENEURIAL ECOSYSTEM 12

Understanding the Entrepreneurial Ecosystem – Components: Angels, Venture Capitalists, Maker Spaces, Incubators, Accelerators, Investors. Financing models – equity, debt, crowdfunding, etc, Support from the government and corporates. Navigating Ecosystem Support: Searching & Identifying the Right Ecosystem Partner – Leveraging the Ecosystem-Building the right stakeholder network.

Activity Session: Arrangement of Guest Speaker Sessions by successful entrepreneurs and entrepreneurial ecosystem leaders (incubation managers, angels, etc), Visit one or two entrepreneurial ecosystem players (Travel and visit a research park or incubator or makerspace or interact with startup founders).

TOTAL: (L:30; P:30) 60 PERIODS

COURSE OUTCOMES

At the end of the course, the student should be able to

1. Develop an Entrepreneurial Mind-set and Understand the Entrepreneurial Ecosystem Components and Funding types
2. Apply the design thinking process to identify entrepreneurial opportunities, assess market potential, and define target customers.
3. Generate and develop creative ideas through ideation techniques
4. Create prototypes to materialize design concepts and conduct testing to gather feedback and refine prototypes to build a validated MVP
5. Analyse and refine business models to ensure sustainability and profitability Prepare and deliver an investible pitch deck of their practice venture to attract stakeholders.

REFERENCES

1. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Sabyasachi Sinha (2023). Entrepreneurship, McGrawHill, 12th Edition.
2. Bill Aulet (2024). Disciplined Entrepreneurship: 24 Steps to a Successful Startup. John Wiley & Sons.
3. Bill Aulet (2017). Disciplined Entrepreneurship Workbook. John Wiley & Sons.
4. Ries, E. (2011). The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses. Crown Business
5. Blank, S. G., & Dorf, B. (2020). The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company. K&S Ranch.
6. Osterwalder, A., & Pigneur, Y. (2010). Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers. John Wiley & Sons
7. Marc Gruber & Sharon Tal (2019). Where to Play: 3 Steps for Discovering Your Most Valuable Market Opportunities. Pearson

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	—	2	—	—	—	—	3	3	3	3	2
CO2	—	—	—	—	—	—	—	—	—	—	2	1	2	3	2
CO3	—	3	3	2	—	2	—	—	—	—	2	2	3	3	2
CO4	—	—	—	—	—	—	—	—	—	—	3	2	2	3	1
CO5	—	3	3	3	—	—	—	—	—	—	2	2	3	3	2
Avg.	**3**	**3**	**3**	**2**	—	**2**	—	—	—	—	**2**	**2**	**3**	**3**	**2**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix

24ME3552 HEAT AND MASS TRANSFER

L	T	P	C
3	**0**	**2**	**4**

COURSE OBJECTIVES

1. To analyze the principles of heat transfer mechanisms under steady-state and transient conditions to solve engineering problems.
2. To apply fundamental principles of convective heat transfer for practical thermal system analysis and design.
3. To apply phase-change heat transfer theory to design and analyze heat exchangers for industrial applications.
4. To analyze radiation heat transfer principles in thermal system evaluation and engineering calculations.
5. To develop the basic concept and diffusion, convective di mass transfer.

UNIT I CONDUCTION 15

General Differential equation of Heat Conduction– Cartesian and Polar Coordinates – One Dimensional Steady State Heat Conduction — plane and Composite Systems – Conduction

with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Semi Infinite and Infinite Solids –Use of Heisler's charts.

PRACTICAL

1. Thermal conductivity measurement of pipe insulation using lagged pipe apparatus.
2. Determination of thermal conductivity of a composite wall, insulating powder, oils, and water.

UNIT II CONVECTION 15

Free and Forced Convection - Hydrodynamic and Thermal Boundary Layer. Free and Forced Convection during external flow over Plates and Cylinders and Internal flow through tubes.

PRACTICAL

1. Determination of heat transfer coefficient of air under natural convection and forced convection.
2. Heat transfer from pin-fin under natural and forced convection.

UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS 15

Nusselt's theory of condensation - Regimes of Pool boiling and Flow boiling. Correlations in boiling and condensation. Heat Exchanger Types - Overall Heat Transfer Coefficient – Fouling Factors - Analysis – LMTD method - NTU method.

PRACTICAL

1. Determination of friction factor, heat transfer coefficient of cold/hot fluid and effectiveness of a tube-in-tube heat exchanger.

UNIT IV RADIATION 15

Black Body Radiation – Grey body radiation - Shape Factor – Electrical Analogy – Radiation Shields. Radiation through gases.

PRACTICAL

1. Determination of emissivity of a grey surface.
2. Determination of Stefan - Boltzmann constant

UNIT V MASS TRANSFER 15

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations.

TOTAL: (L:45; P:30) 75 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Apply heat conduction equations to different surface configurations under steady state and transient conditions and solve problems.
2. Apply free and forced convective heat transfer correlations to internal and external flows through/over various surface configurations and solve problems.
3. Apply the principles of boiling and condensation, and use LMTD and NTU methods to analyze and solve heat transfer problems in various heat exchanger configurations.
4. Analyze fundamental radiation laws to evaluate radiative heat transfer between different surface configurations and solve related problems.
5. Apply diffusive and convective mass transfer equations and correlations to solve problems for different applications.

TEXT BOOKS

1. R.C. Sachdeva, "Fundamentals of Engineering Heat & Mass transfer", New Age International Publishers, 6th Edition 2023.
2. Yunus A. Cengel, "Heat Transfer A Practical Approach" – Tata McGraw Hill, 6th Edition – 2020.

REFERENCES

1. Frank P. Incropera and David P. Dewitt, "Fundamentals of Heat and Mass Transfer", John Wiley & Sons, 8th Edition, 2020.
2. Holman, J.P., "Heat and Mass Transfer", Tata McGraw Hill, 2010.
3. Kothandaraman, C.P., "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, 2012.
4. Ozisik, M.N., "Heat Transfer", McGraw Hill Book Co., 1994.
5. S.P . Venkateshan, "Heat Transfer", Ane Books, New Delhi, 2021.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	1	2	-	1	1	2	3	3	3	2
CO2	3	3	3	2	1	1	2	-	2	1	2	3	3	3	2
CO3	3	3	3	2	1	1	2	-	2	1	3	3	3	3	2
CO4	3	3	3	2	1	1	2	-	2	1	3	3	3	3	2
CO5	3	3	3	2	1	1	2	1	2	1	3	3	3	3	2
Avg.	**3**	**3**	3	**2**	**1**	**1**	**2**	**1**	**2**	1	**3**	**3**	**3**	3	**2**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix

24ME3553 METROLOGY AND MEASUREMENTS

L	T	P	C
2	0	2	3

COURSE OBJECTIVES

1. To explain fundamental concepts of metrology to ensure accurate measurements and quality control in manufacturing.
2. To interpret linear and angular dimensions of components, assemblies, and transmission elements using appropriate metrological instruments.
3. To apply tolerance analysis techniques to assess manufacturability and functional performance of mechanical components.
4. To develop the fundamentals of GD & T and surface metrology.
5. To apply advanced measurement techniques for effective quality control in manufacturing industries.

UNIT I BASICS OF METROLOGY 12

Measurement-Need, Process, Role in quality control; Factors affecting measurement SWIPE: Errors in Measurements Types Control Measurement Uncertainty Types. Estimation, Problems on Estimation of Uncertainty, Statistical analysis of measurement data, Measurement system analysis. Calibration of measuring instruments, Principle of air gauging. ISO standards.

UNIT II MEASUREMENT OF LINEAR, ANGULAR DIMENSIONS, ASSEMBLY AND TRANSMISSION ELEMENTS 12

Linear Measuring Instruments Vernier caliper, Micrometer, Vernier height gauge, Depth Micrometer, Bore gauge. Telescoping gauge: Gauge blocks - Use and precautions, Comparators - Working and advantages: Opto-mechanical measurements using measuring microscope and Profile Projector-Angular measuring instruments Bevel protractor, Clinometer, Angle gauges, Precision level, Sine bar, Autocollimator, Angle dekkor, Alignment telescope. Measurement of Screw threads Single element measurements Pitch Diameter, Lead, Pitch. Measurement of Gears purpose Analytical measurement - Runout, Pitch variation, Tooth profile, Tooth thickness, Lead Functional checking - Rolling gear test.

PRACTICAL

1. Calibration and use of linear measuring instruments – Vernier caliper, micrometer, Vernier height gauge, depth micrometer, telescopic gauge, Comparators.
2. Measurement of angles using bevel protractor, sine bar, autocollimator, precision level.
3. Study of gear parameters

UNIT III TOLERANCE ANALYSIS 12

Tolerancing- Interchangeability, Selective assembly, Tolerance representation, Terminology, Limits and Fits, Problems (using tables IS919); Design of Limit gauges, Problems. Tolerance analysis in manufacturing. Process capability, tolerance stack up, tolerance charting

PRACTICAL

1. Measurement of Limits, Fits and Tolerances using micrometer
2. Checking dimensions of part using slip gauges

UNIT IV METROLOGY OF SURFACES 12

Fundamentals of GD & T. Conventional vs Geometric tolerance, Datums, Inspection of geometric deviations like straightness, flatness, roundness deviations: Simple problems - Measurement of Surface Finish-Functionality of surfaces, Parameters, Comparative, Stylus based and Optical Measurement techniques, Filters, Introduction to 3D surface metrology-Parameters.

UNIT V ADVANCES IN METROLOGY 12

Lasers in metrology - Advantages of lasers – Laser scan micrometers -Laser interferometers-Applications-Straightness, Alignment; Ball bar tests, Computer Aided Metrology-Basic concept of CMM-Types of CMM-Constructional features - Probes - Accessories - Software Applications - Multi-sensor CMMS. Machine Vision Basic concepts of Machine Vision System - Elements - Applications On-line and in- process monitoring in production Computed tomography - White light Scanners

PRACTICAL

1. Measurement of features in a prismatic component using Coordinate Measuring Machine (CMM)

TOTAL: (L:30; P:30) 60 PERIODS

COURSE OUTCOMES

After successful completion of the course, the students will be able

1. Apply measurement concepts in the selection and use of various metrological instruments.
2. Apply the principle and applications of linear and angular measuring instruments, assembly and transmission elements.
3. Apply the tolerance symbols and tolerance analysis for industrial applications.
4. Apply the principles and methods of form and surface metrology.
5. Apply the advances in measurements for quality control in manufacturing Industries.

TEXT BOOKS

1. Dotson Connie, "Dimensional Metrology", Cengage Learning, Sixth edition, 2016.
2. Mark Curtis, Francis T. Farago, "Handbook of Dimensional Measurement", Industrial Press, Fifth edition, 2013.

REFERENCES

1. Ammar Grous, J "Applied Metrology for Manufacturing Engineering", Wiley-ISTE, 2011.
2. Galyer, J.F.W. Charles Reginald Shot bolt, "Metrology for Engineers", Cengage Learning EMEA; 5th revised edition, 1990.
3. National Physical Laboratory Guide No. 40. No. 41, No. 42, No. 43, No. 80, No. 118, No. 130, No. 131. http://www.npl.co.uk.
4. Raghavendra N.V. and Krishnamurthy. L., Engineering Metrology and Measurements. Oxford University Press, 2013.
5. Venkatesan, S. P., "Mechanical Measurements", Second edition, John Wiley & Sons, 2015.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	—	1	1	3	3	—	1	2	2	—	2	3	2	1
CO2	3	2	3	1	3	3	2	2	2	2	—	2	3	2	3
CO3	3	—	3	1	3	3	2	—	3	2	—	2	3	2	3
CO4	3	2	2	2	3	3	2	2	2	2	2	2	3	2	3
CO5	3	—	2	—	1	3	—	2	2	2	—	2	3	2	2
Avg.	3	1	3	2	3	3	2	2	3	3	1	3	3	3	3

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix

24ME3511 **CAD / CAM LABORATORY**

L	T	P	C
0	**0**	**4**	**2**

COURSE OBJECTIVES

1. To apply 3D models and assembly models of common machine components using appropriate CAD software.
2. To interpret manual drawing techniques to accurately represent and analyze industrial machine elements.
3. To develop competency in manual CNC part programming for machining and turning operations.

4. To apply advanced CNC operations, including canned cycles, tool compensation, and multi-axis machining, for efficient manufacturing.
5. To apply CL data using CAM packages and understand Computer-Aided Process Planning (CAPP) for automated manufacturing processes.

LIST OF EXPERIMENTS

I. 3D GEOMETRIC MODELLING 30

CAD Introduction

Sketch:

Solid modeling: Extrude, Revolve, Sweep, Variational sweep and Loft.
Surface modeling: Extrude, Sweep, Trim, Mesh of curves and Free form.
Feature manipulation: Copy, Edit, Pattern, Suppress, History operations.
Assembly: Constraints, Exploded Views, Interference check
Drafting: Layouts, Standard & Sectional Views, Detailing & Plotting

Creation of 3D assembly model of following machine elements using 3D Modelling software

1. Flange Coupling
2. Plummer Block
3. Screw Jack
4. Lathe Tailstock
5. Universal Joint
6. Machine Vice
7. Stuffing box
8. Crosshead
9. Safety Valves
10. Non-return valves
11. Connecting rod
12. Piston
13. Crankshaft

* Students may also be trained in manual drawing of some of the above components (specify the number – progressive arrangement of 3D)

II Manual Part Programming. 30

(i) Part Programming - CNC Machining Centre

a) Linear Cutting.
b) Circular cutting.
c) Cutter Radius Compensation.
d) Canned Cycle Operations.

(ii) Part Programming - CNC Turning Centre

a) Straight, Taper and Radius Turning.
b) Thread Cutting.
c) Rough and Finish Turning Cycle.
d) Drilling and Tapping Cycle.

III. Computer Aided Part Programming

a) Generate CL Data and Post process data using CAM packages for Machining and Turning Centre
b) Application of CAPP in Machining and Turning Centre.

TOTAL: 60 PERIODS

S.No.	Description of Equipment	Qty
HARDWARE		
1.	Computer Server	1
2.	Computer nodes or systems (High end CPU with atleast 1 GB main memory) networked to the server 30	30
3.	A3 size plotter	1
4.	Laser Printer	1
5.	CNC Lathe	1
6.	CNC milling machine	1
SOFTWARE		
7.	Any High end integrated modeling and manufacturing CAD / CAM software	15 licenses
8.	CAM Software for machining centre and turning centre (CNC Programming and tool path simulation for FANUC / Sinumeric and Heidenhain controller)	15 licenses
9.	Licensed operating system	Adequate
10.	Support for CAPP	Adequate

COURSE OUTCOMES

On successful completion of this laboratory, the student will be able to:

1. Create accurate 3D models, assembly drawings, and representations of standard machine components using CAD/3D modelling software.
2. Prepare manual engineering drawings and interpret dimensions, tolerances, and manufacturing details of industrial machine elements.
3. Develop and execute manual CNC part programs for both machining centre and turning centre operations involving linear, circular, threading, and drilling cycles.
4. Perform CNC machining operations using canned cycles, cutter radius compensation, tool offsets, and multi-axis machining procedures in an industrial environment.

5. Generate CL data, produce NC code using CAM software, and apply CAPP methodologies for automated machining and manufacturing processes.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	1	-	-	-	-	3	3	3	2	2
CO2	3	3	3	3	2	1	-	-	-	-	2	2	3	2	2
CO3	3	3	3	3	2	1	-	-	-	-	3	3	3	2	2
CO4	3	3	3	3	2	1	-	-	-	-	3	3	3	2	2
CO5	3	3	3	3	2	1	-	-	-	-	3	3	3	2	2
Avg.	**3**	**3**	**3**	**3**	**2**	**1**	-	-	-	-	**3**	**3**	**3**	**2**	**2**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix

24TP3501 **SKILL ENHANCEMENT – V**

L	T	P	C
0	**0**	**2**	**1**

COURSE OBJECTIVES

1. To apply self-assessment and reflective techniques to enhance personal growth and professional development.
2. To develop and demonstrate effective communication skills for academic, professional, and social interactions.
3. To cultivate and exhibit a positive attitude, confidence, and professional etiquette in workplace and team settings.
4. To apply creative thinking and problem-solving skills to academic projects and real-world scenarios.
5. To utilize digital productivity tools to efficiently manage tasks, collaborate, and achieve professional objectives.

UNIT I – Quantitative Ability **6**

- ✓ Probability Applications in Hiring Assessments
- ✓ Number System (Advanced problem types)
- ✓ Statistics: Distribution types, Outliers, Skewness
- ✓ Variance & Standard Deviation for real-world analytics
- ✓ Area & Mensuration – Industry case-based problems

Activities

- ✓ Solve 20 industry-based quantitative aptitude problems
- ✓ Perform variance & standard deviation calculation using real datasets

UNIT II – Verbal Ability **6**

- ✓ Direct & Indirect Speech – advanced contextual usage
- ✓ Active–Passive Voice transformations in professional writing
- ✓ Applied Tenses for workplace & technical communication
- ✓ Vocabulary Building – domain-based word banks (IT, business, HR)

Activities

- ✓ Convert informal statements into formal business email language
- ✓ Rewrite 10 sentences using proper tense & voice transformation

UNIT III – Reasoning Ability **6**

- ✓ Blood Relations – symbolic & coded
- ✓ Logical Arrangement & Ranking
- ✓ Direction-based reasoning
- ✓ Data Interpretation – charts & tables used in placements

Activities

- ✓ Reasoning test (Blood relations, Directions, Ranking)
- ✓ Solve logical arrangement puzzles

UNIT IV – Employability Aptitude **6**

- ✓ Error spotting in professional communication
- ✓ Reading & interpreting English passages
- ✓ Word usage in business contexts
- ✓ Grammar application in real-time scenarios
- ✓ Pattern-based language solving

Activities

- ✓ Peer-review: Correct real-world grammatical errors in office communication
- ✓ Comprehension practice (short business passages)

UNIT V – Workplace Communication & Career Readiness **6**

- ✓ Foundations of workplace messaging
- ✓ Business email writing (formal tone, agenda clarity)
- ✓ Resume fundamentals – first resume creation
- ✓ Skills mapping & achievement recording
- ✓ LinkedIn basics – headline, skills, visibility
- ✓ Identifying internship opportunities
- ✓ Digital learning platforms—Coursera/Udemy/TCS iON credential showcasing

Activities

- ✓ Create first professional resume (mandatory)
- ✓ Draft 3 internship-request emails
- ✓ Build LinkedIn headline & about section

TOTAL: 30 PERIODS

COURSE OUTCOMES

At the end of the course, the students will be able to:

1. Apply quantitative and statistical methods to solve aptitude-based problems effectively.
2. Apply advanced grammar and vocabulary to enhance clarity and effectiveness in written communication.
3. Analyze and solve reasoning-based analytical problems with accuracy and logical justification.
4. Analyze, interpret, and correct language errors in contextual and professional usage.
5. Create and present internship-oriented resumes and develop a professional LinkedIn profile to enhance career readiness.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	–	2	1	–	–	–	2	-	-	2	1	3	2
CO2	–	–	–	–	2	–	–	–	3	3	1	2	–	1	2
CO3	3	3	–	2	–	–	–	–	2	-	-	2	1	3	2
CO4	–	–	–	–	3	–	–	–	2	3	2	2	–	1	1
CO5	–	–	–	-	3	–	–	–	3	2	3	3	–	–	3
Avg.	**3**	**3**	**–**	**2**	**1**	**–**	**–**	**–**	**2**	**-**	**-**	**2**	**1**	**3**	**2**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix

REFERENCES

1. Aggarwal, R. S., Quantitative Aptitude for Competitive Examinations, S. Chand Publishing, 2025.
2. Aggarwal, R. S., A Modern Approach to Verbal & Non-Verbal Reasoning, S. Chand Publishing, 2025.
3. Raman, M. and Sharma, S., Technical Communication: Principles and Practice, Oxford University Press, 2019.
4. Guffey, M. E. and Loewy, D., Business Communication: Process and Product, Cengage Learning, 2025.
5. Yate, M., Knock 'em Dead Resumes: A Killer Resume Gets More Job Interviews!, Adams Media, 2016

24HS3001 UNIVERSAL HUMAN VALUES

L	T	P	C
2	0	0	2

COURSE OBJECTIVES

1. To apply the interrelationship between values and skills to promote sustained happiness and prosperity in personal and professional life.
2. To develop a holistic perspective towards life, profession, and well-being, grounded in an understanding of human reality and existence.
3. To evaluate holistic understanding in fostering ethical conduct, trustful behavior, and mutually enriching interactions with others and the environment.
4. To apply foundational principles of value education to guide decision-making and promote value-based living in everyday life.
5. To develop an understanding of natural acceptance as the foundational basis for human values and enable students to evaluate their thoughts and actions in alignment with ethical living.

UNIT I INTRODUCTION TO VALUE EDUCATION 6

Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations.

UNIT II HARMONY IN THE HUMAN BEING 6

Understanding Human being as the Co-existence of the Self and the Body, distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health.

UNIT III HARMONY IN THE FAMILY AND SOCIETY 6

Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order.

UNIT IV HARMONY IN THE NATURE / EXISTENCE 6

Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence.

UNIT V IMPLICATIONS OF THE HOLISTIC UNDERSTANDING – A LOOK AT PROFESSIONAL ETHICS 6

Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in

Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession.

TOTAL: 30 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Apply the concepts of right understanding, relationships, and physical facilities, and assess their contribution to holistic human development.
2. Apply the understanding of the needs of the self and the body to demonstrate harmony within the human being through self-regulation and healthy living.
3. Evaluate the importance of trust, respect, and other feelings in family relationships, and interpret how these values contribute to harmony in society and the universal human order.
4. Apply the concept of harmony in nature by examining mutual fulfilment and interconnectedness among the four orders, and develop a holistic perception of coexistence.
5. Apply the principles of holistic understanding and human values to professional ethics, demonstrating ethical conduct, responsible decision-making, and strategies for a value-based lifestyle and profession.

TEXT BOOKS

1. A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 3rd Revised Edition, Excel Books, New Delhi, 2023. ISBN 978-93-87034-47-1.
2. The Teacher's Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 3rd Revised Edition, Excel Books, New Delhi, 2023. ISBN 978-93-87034-53.

REFERENCES

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amar kantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	1	1	3	3	3	2	2	2	3	1	1	2
CO2	1	2	1	1	1	3	3	3	2	2	2	3	1	1	2
CO3	1	2	1	1	1	3	3	3	2	2	2	3	1	1	2
CO4	1	1	1	1	1	3	3	2	1	1	1	3	1	1	2
CO5	1	2	2	1	1	3	3	3	2	3	3	3	1	1	2
Avg.	**2**	**3**	**2**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**1**	**2**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix

24ME3651 DESIGN OF TRANSMISSION SYSTEMS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. To apply principles and procedures for the design of mechanical power transmission components in practical engineering applications.
2. To analyze and design mechanical elements such as spur gears and parallel axis helical gears using standard design procedures.
3. To design bevel, worm, and crossed helical gears for mechanical transmission systems.
4. To design multi-speed and variable-speed gearboxes for machine tool applications.
5. To design cams, brakes, and clutches for effective mechanical system operation.

(Use of PSG Design Data Book permitted)

UNIT I DESIGN OF FLEXIBLE ELEMENTS 9

Design of Flat belts and pulleys - Selection of V belts and pulleys – Selection of hoisting wire ropes and pulleys – Design of Transmission Chains.

UNIT II SPUR GEARS AND PARALLEL AXIS HELICAL GEARS 9

Speed ratios and number of teeth-Force analysis -Tooth stresses - Dynamic effects – Fatigue strength - Factor of safety - Gear materials – Design of straight tooth spur & helical gears based on strength and wear considerations – Pressure angle in the normal and transverse plane-Equivalent number of teeth-forces for helical gears.

UNIT III BEVEL, WORM AND CROSS HELICAL GEARS 9

Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears. Worm Gear: Merits and demerits terminology. Thermal capacity, materials-forces and stresses, efficiency, estimating the size of the worm gear pair. Cross helical: Terminology-helix angles-Estimating the size of the pair of cross helical gears.

UNIT IV GEAR BOXES 9

Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box - Design of multi speed gear box for machine tool applications - Constant mesh gear box - Speed reducer unit. – Variable speed gear box.

UNIT V CLUTCHES AND BRAKES 9

Design of plate clutches –axial clutches-cone clutches-internal expanding rim clutches-Electromagnetic clutches. Block brakes - external shoe brakes – Internal expanding shoe brake.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to

1. Select a material for a power transmission element catering to various industrial applications
2. Apply standard procedures for design power drives for various applications.
3. Analyze stresses induced in the power transmission systems.
4. Design the mechanical transmission systems for various applications
5. Design various clutches and brake systems by applying principles of power transmission, friction, and braking mechanics.

TEXT BOOKS

1. Bhandari V B, “Design of Machine Elements”, 5th Edition, Tata McGraw-Hill Book Co, 2020
2. Joseph Shigley, Richard G. Budynas and J. Keith Nisbett “Mechanical Engineering Design” 12th Edition, Tata McGraw-Hill, 2025.

REFERENCES

1. Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger, “Design of Machine Elements” 8th Edition, Printice Hall, 2019.
2. Orthwein W, “Machine Component Design”, Jaico Publishing Co, 2003.
3. Prabhu. T.J., “Design of Transmission Elements”, Mani Offset, Chennai, 2000.
4. Robert C. Juvinall and Kurt M. Marshek, “Fundamentals of Machine Design”, 7th Edition, 2020.
5. Sundararajamoorthy T. V, Shanmugam.N, “Machine Design”, Anuradha Publications, Chennai, 2003.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	1	-	-	-	-	3	3	3	2	2
CO2	3	3	3	3	2	1	-	-	-	-	2	2	3	2	2
CO3	3	3	3	3	2	1	-	-	-	-	3	3	3	2	2
CO4	3	3	3	3	2	1	-	-	-	-	3	3	3	2	2
CO5	3	3	3	3	2	1	-	-	-	-	3	3	3	2	2
Avg.	**3**	**3**	**3**	**3**	**2**	**1**	-	-	-	-	**3**	**3**	**3**	2	2

“1” - low, “2” - medium, “3” - high, “-” - no correlation

Note: The average value of this course to be used for program articulation matrix

24ME3653 **FINITE ELEMENT ANALYSIS**

L	T	P	C
3	0	2	4

COURSE OBJECTIVES

1. To apply basic Finite Element Method (FEM) concepts to model engineering problems for analysis.
2. To interpret 1D systems using shape functions, stiffness matrices, and FEM software for practical engineering applications.
3. To apply FEM to 2D problems using triangular and quadrilateral elements for thermal and torsional analysis.
4. To apply FEM techniques to solve elasticity problems in plane stress, plane strain, axisymmetric components, plates, and shells.
5. To analyze iso-parametric elements, numerical integration, meshing strategies, and nonlinear FEM methods for practical engineering simulations.

UNIT I INTRODUCTION 15

Historical Background – Mathematical Modelling of field problems in Engineering – Governing Equations –Discrete and continuous models – Boundary, Initial and Eigen Value problems– Weighted Residual Methods– Variational Formulation of Boundary Value Problems – Ritz Technique – Basic concepts of the Finite Element Method.

PRACTICAL

1. Introduction to analysing software.

UNIT II ONE-DIMENSIONAL ANALYSIS 15

One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors- Assembly of Matrices -Solution of problems from solid mechanics including thermal stresses- heat transfer. Natural frequencies of longitudinal vibration and mode shapes. Fourth Order Beam Equation – Transverse deflections and Transverse Natural frequencies of beams.

PRACTICAL

1. Modelling and analysis of 1D elements (bars, beams) using FEM software.

UNIT III TWO-DIMENSIONAL SCALAR VARIABLE ANALYSIS 15

Second Order 2D Equations involving Scalar Variable Functions – Variational formulation – Finite Element formulation – Triangular elements and Quadrilateral elements- Shape functions and element matrices and vectors. Application to Field Problems - Thermal problems – Torsion of Non-circular shafts.

PRACTICAL

1. Modelling and analysis of 2D truss elements using FEM software.

2. Thermal analysis (steady-state and transient heat conduction).

UNIT IV TWO-DIMENSIONAL VECTOR VARIABLE ANALYSIS 15

Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Constitutive matrices and Strain displacement matrices – Stiffness matrix – Stress calculations - Plate and shell elements.

PRACTICAL

1. Static structural analysis (beams, frames).
2. Modal analysis of beams and plates.

UNIT V ISOPARAMETRIC FORMULATION 15

Natural co-ordinate systems – Iso-parametric elements – Shape functions for iso-parametric elements– One and two dimensions – Serendipity elements – Numerical integration - Meshing techniques.

TOTAL: (L:45; P:30) 75 PERIODS

Software: ANSYS/ABAQUS/NASTRAN.

COURSE OUTCOMES

At the end of the course, the students will be able to

1. Apply the method to 1D, 2D, and 3D engineering applications.
2. Apply element stiffness matrices to construct global system matrices for structural and thermal analysis.
3. Apply and evaluate FEM software tools to solve practical structural and thermal engineering problems.
4. Evaluate limitations of FEM and apply appropriate meshing and modelling techniques.
5. Analyze real-world engineering problems through case studies and lab projects.

TEXT BOOKS

1. Rao, S.S., “The Finite Element Method in Engineering”, 6th Edition, Butterworth-Heinemann, 2018.

REFERENCES

1. David Hutton, “Fundamentals of Finite Element Analysis”, Tata McGrawHill, 2005.
2. Dhanaraj. R and Prabhakaran Nair. K, “Finite Element Analysis”, Oxford Publications, 2015.
3. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, “Concepts and Applications of Finite Element Analysis”, 4th Edition, Wiley Student Edition, 2004.
4. Seshu. P, “Text Book of Finite Element Analysis”, PHI Learning Pvt. Ltd., New Delhi, 2012.
5. Tirupathi R.Chandrupatla and Ashok D. Belegundu, “Introduction to Finite Elements in Engineering”, International Edition, Pearson Education Limited, 2021.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	1	-	-	-	-	3	3	3	2	2
CO2	3	3	3	3	2	1	-	-	-	-	2	2	3	2	2
CO3	3	3	3	3	2	1	-	-	-	-	3	3	3	2	2
CO4	3	3	3	3	2	1	-	-	-	-	3	3	3	2	2
CO5	3	3	3	3	2	1	-	-	-	-	3	3	3	2	2
Avg.	**3**	**3**	**3**	**3**	**2**	**1**	-	-	-	-	**3**	**3**	**3**	2	2

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix

24ME3611 AUTOMOTIVE ENGINEERING LABORATORY

L	T	P	C
0	**0**	**4**	**2**

COURSE OBJECTIVES

1. To analyze the fundamental structure and major systems of an automobile and their functional relationships.
2. To develop hands-on skills in dismantling, inspecting, and assembling key automotive components.
3. To apply and diagnostic procedures for automotive electrical and mechanical systems.
4. To analyze the working principles and functional performance of braking, axle, and transmission systems.
5. To evaluate the physical properties of automotive lubricants, oils, and exhaust emissions.

LIST OF EXPERIMENTS

1) Study of an Automobile Chassis

2) Dismantling and Assembling of Single plate, Diaphragm Clutch

3) Dismantling and Assembling of Front and Rear axle.

4) Study of Braking System (Hydraulic / Air Brake)

5) Testing of Battery – Hydrometer, Load test, Individual Cell voltage test, Jump Start

6) Tightening and adjustment of wheel bearing.

7) Removal and fitting of tyre.

8) Exhaust Gas testing

9) Determination of Viscosity of lubricants / oils

10) Determination of density, specific gravity of oils

COURSE OUTCOMES

On successful completion of this laboratory, the student will be able to:

1. Explain the construction and layout of an automobile chassis and major systems.
2. Dismantle and assemble clutch, axle, and wheel components with proper tools and procedures.
3. Perform battery tests including hydrometer reading, load test, and cell voltage measurement.
4. Apply and demonstrate procedures for tyre removal, wheel bearing adjustment, and brake system operation.
5. Analyze properties of oils such as viscosity, density, and specific gravity, and conduct exhaust gas emission testing to assess engine performance.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	2	2	1	1	1	1	1	2	2	1	1
CO2	2	2	2	2	3	2	1	1	2	1	2	2	3	1	2
CO3	2	3	1	3	3	2	1	1	1	1	1	2	2	2	2
CO4	2	3	2	2	3	1	1	1	2	2	1	2	2	2	3
CO5	2	3	1	3	3	3	3	1	1	2	1	2	2	3	2
Avg.	**3**	**3**	**2**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**3**	**3**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix

24ME3612 DESIGN AND FABRICATION PROJECT

L	T	P	C
0	**0**	**4**	**2**

COURSE OBJECTIVES

1. To analyze a real-time engineering problem suitable for project development.
2. To develop students' abilities to design, model, and fabricate a working prototype or system using appropriate engineering tools and practices.
3. To apply and demonstrate teamwork, planning, coordination, and project management skills through effective group-based project execution.
4. To develop and demonstrate technical communication skills through structured project reports, documentation, and oral presentations.
5. To analyze and apply industry practices by engaging with project supervisors and, where possible, industry collaborators.

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GUIDELINES FOR REVIEW AND EVALUATION

Students may be divided into groups of two to four and work with a project supervisor. The device/system/component(s) to be constructed may be determined in cooperation with the supervisor and, if feasible, industry. The group will present a project report and a manufactured model, which will be inspected and appraised for internal evaluation by a committee chaired by the Department Head. At the conclusion of the semester assessment, external and internal examiners appointed by the Head of the Department to evaluate the project work based on an oral presentation and a project report.

TOTAL: 60 PERIODS

COURSE OUTCOMES

At the end of the course, the student should be able to

1. Identify an engineering problem, formulate objectives, and develop a feasible project plan.
2. Apply engineering concepts, design methodologies, and fabrication skills to develop a functional prototype or system.
3. Work effectively as a team, demonstrating coordination, time management, and shared responsibility.
4. Prepare a professional project report with proper technical documentation, drawings, analysis, and justification.
5. Communicate project outcomes clearly through oral presentations and defend technical decisions before evaluators.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	2	2	1	1	2	2	3	3	2	2	2	2
CO2	3	3	3	3	3	1	1	2	1	2	2	2	3	3	3
CO3	1	2	2	1	1	1	1	3	3	3	3	2	1	1	3
CO4	1	2	2	2	2	1	1	2	3	2	2	2	2	2	2
CO5	1	2	2	2	2	1	1	2	3	3	3	2	2	2	3
Avg.	**2**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix

24TP3601 **SKILL ENHANCEMENT – VI**

L	T	P	C
0	0	2	1

COURSE OBJECTIVE

1. To apply advanced quantitative, verbal, and logical reasoning techniques to solve complex aptitude and analytical problems in competitive placement examinations.
2. To apply and optimize quantitative and logical problem-solving strategies to improve accuracy and performance under time-bound conditions.
3. To analyze and evaluate verbal reasoning skills, including comprehension, vocabulary, and critical interpretation, for professional and assessment contexts.
4. To create and refine professional resumes, portfolios, and tailored cover letters aligned with industry standards and recruiter expectations.
5. To apply and demonstrate effective workplace communication skills, including written, verbal, and presentation abilities, for confident professional interaction.

UNIT I – QUANTITATIVE ABILITY **6**

- ✓ Permutation & Combination (combinatorial thinking)
- ✓ Surds & Indices (exponent simplification)
- ✓ Geometry – advanced property-based problems
- ✓ Trigonometry – identities & applications in engineering

Activities

- ✓ Solve previous-year national-level aptitude tests (TCS NQT / AMCAT / CoCubes)

UNIT II – VERBAL ABILITY **6**

- ✓ One-word substitution
- ✓ Sentence completion
- ✓ Data-arrangement in language contexts
- ✓ Vocabulary expansion – roots, etymology, prefixes/suffixes

Activities

- ✓ Build a vocabulary bank using root-based technique
- ✓ Practice one-word substitution exercises

UNIT III – REASONING ABILITY **6**

- ✓ Critical reasoning arguments
- ✓ Clock reasoning
- ✓ Calendar reasoning
- ✓ Puzzle Tests (seating, floor, distribution, multi-layer constraints)

Activities

- ✓ Solve 10 advanced puzzles (including clock & calendar reasoning)
- ✓ Floor/seating arrangement puzzle-solving worksheets

UNIT IV – CREATIVE & ANALYTICAL ABILITY **6**

- ✓ Para-jumbles
- ✓ Vocabulary analytics – semantic clusters
- ✓ Image analysis
- ✓ Grouping & visual recognition
- ✓ Pattern identification problems

Activities

- ✓ Perform visual pattern recognition tasks
- ✓ Semantic-cluster vocabulary mapping

UNIT V – ADVANCED CAREER READINESS SKILLS **6**

- ✓ Advanced Resume tailoring (role-focused, ATS-optimized)
- ✓ STAR storytelling for experience & achievements
- ✓ Professional cover letters
- ✓ Specialized internship/job-oriented emails
- ✓ GitHub portfolio creation
- ✓ Showcasing project repositories
- ✓ Presentation & articulation for interviews
- ✓ PPT design for final-year project reviews

Activities

- ✓ Create a role-specific ATS-optimized resume
- ✓ Prepare a PPT for final-year project presentation
- ✓ Draft a professional cover letter

TOTAL: 45 PERIODS

COURSE OUTCOMES

At the end of the course, the students will be able to:

1. Apply advanced quantitative concepts to solve complex aptitude assessments.
2. Improve verbal reasoning & structured language use.
3. Solve multi-layer logical puzzles and analytical reasoning tasks.
4. Demonstrate enhanced creative, linguistic & visual reasoning.
5. Develop advanced resumes, personal branding, GitHub & professional presentations.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	–	2	1	–	–	–	1	–	–	2	1	3	2
CO2	–	–	–	–	2	–	–	–	3	3	1	2	–	1	2
CO3	3	3	–	2	–	–	–	–	2	–	1	2	1	3	2
CO4	2	2	–	1	2	–	–	–	2	1	1	2	–	1	2
CO5	–	–	–	–	3	–	–	–	3	3	3	3	–	–	3
Avg.	**2**	**2**	–	**2**	**2**	–	–	–	**2**	**1**	**1**	**2**	**1**	**2**	**2**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix

REFERENCES

1. Aggarwal, R. S., Objective Mathematics for Competitive Examinations, S. Chand Publishing, 2022.
2. Thorpe, E., Test of Reasoning, McGraw Hill Education, 2016.
3. Norman Lewis, Word Power Made Easy, Goyal Publishers, 2014.
4. Guffey, M. E. and Loewy, D., Essentials of Business Communication, Cengage Learning, 2019.
5. Yate, M., Knock 'em Dead Cover Letters, Adams Media, 2017.

24ME3751 COMPUTER INTEGRATED MANUFACTURING

L	T	P	C
3	**0**	**0**	**3**

COURSE OBJECTIVES

1. To analyze the evolution of automation, Computer Integrated Manufacturing (CIM), and its fundamental principles.
2. To apply automation tools, including various material handling systems, for manufacturing applications.
3. To evaluate Group Technology and Flexible Manufacturing Systems (FMS) in automated production environments.
4. To analyze Computer-Aided Process Planning (CAPP) techniques in manufacturing systems.
5. To apply the basics of data transfer, information integration, and control strategies in CIM systems.

UNIT I INTRODUCTION 9

Introduction to CAD, CAM, CAD/CAM and CIM - Evolution of CIM – CIM wheel and cycle – Production concepts and mathematical models – Simple problems in production models – CIM hardware and software – Major elements of CIM system – Three step process for implementation of CIM – Computers in CIM – Computer networks for manufacturing – The future automated factory – Management of CIM – safety aspects of CIM– advances in CIM.

UNIT II AUTOMATED MANUFACTURING SYSTEMS 9

Automated production line – system configurations, work part transfer mechanisms – Fundamentals of Automated assembly system – System configuration, Part delivery at workstations – Design for automated assembly – Overview of material handling equipments – Consideration in material handling system design – The 10 principles of Material handling. Conveyor systems – Types of conveyors – Operations and features. Automated Guided Vehicle system – Types &applications – Vehicle guidance technology – Vehicle management and safety. Storage system performance – storage location strategies – Conventional storage methods and equipments – Automated storage/Retrieval system and Carousel storage system Deadlocks in Automated manufacturing systems – Petrinet models – Applications in Dead lock avoidance – smart manufacturing – Industry 4.0 - Digital manufacturing – Virtual manufacturing.

UNIT III GROUP TECHNOLOGY AND FMS 9

Part families – Visual – Parts classification and coding – Production flow analysis – Grouping of parts and Machines by rank order clustering method – Benefits of GT – Case studies. FMS – Components – workstations – FMS layout configurations – Computer control systems – FMS planning and implementation issues – Architecture of FMS – flow chart showing various operations in FMS – Machine cell design – Composite part concept, Holier method, Key machine concept – Quantitative analysis of FMS – Bottleneck model – Simple and complicated problems – Extended Bottleneck model - sizing the FMS ─ FMS applications, Benefits.

UNIT IV PROCESS PLANNING 9

Process planning – Activities in process planning, Information required. From design to process planning – classification of manufacturing processes – Selection of primary manufacturing processes – Sequencing of operations according to Anteriorities – various examples – forming of Matrix of Anteriorities – case study. Typical process sheet – case studies in Manual process planning. Computer Aided Process Planning – Process planning module and data base – Variant process planning – Two stages in VPP – Generative process planning – Flow chart showing various activities in generative PP – Semi generative process planning- Comparison of CAPP and Manual PP.

UNIT V PROCESS CONTROL AND DATA ANALYSIS 9

Introduction to process model formulation – linear feedback control systems – Optimal control – Adaptive control –Sequence control and PLC& SCADA. Computer process control – Computer process interface – Interface hardware – Computer process monitoring – Direct digital control and Supervisory computer control - Overview of Automatic identification methods – Bar code technology –Automatic data capture technologies - Quality management (SPC) and automated inspection.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Analyze the fundamentals of computer-aided engineering for solving engineering problems.
2. Apply appropriate automotive tools and material handling systems for manufacturing applications.
3. Analyze group technology, FMS, and automation identification methods for effective production planning.
4. Design computer-aided process planning (CAPP) strategies for manufacturing various components.
5. Apply computer process control techniques for monitoring and optimizing manufacturing processes.

TEXT BOOKS

1. Shivanand H K, Benal M M and Koti V, Flexible Manufacturing System, New Age, 2016.
2. CIM: Computer Integrated Manufacturing: Computer Steered Industry Book by August-Wilhelm Scheer.

REFERENCES

1. Alavudeen and Venkateshwaran, Computer Integrated Manufacturing‖, PHI Learning Pvt. Ltd., New Delhi, 2013.
2. Gideon Halevi and Ronald D. Weill, Principles of Process Planning‖, Chapman Hall, 1995.
3. James A. Retrg, Herry W. Kraebber, Computer Integrated Manufacturing‖, Pearson Education, Asia, 3rd Edition, 2004.
4. Mikell P. Groover, Automation, Production system and Computer integrated Manufacturing, Prentice Hall of India Pvt. Ltd.,
5. 5th Edition, 2019.
6. Radhakrishnan P, Subramanian S and Raju V, CAD/CAM/CIM, New Age International Publishers, 3rd Edition, 2008.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	–	–	2	2	1	–	1	2	–	2	3	2	3
CO2	3	3	2	2	3	3	2	–	1	2	–	3	3	2	3
CO3	3	3	3	3	2	2	2	–	1	2	–	3	3	2	3
CO4	3	3	2	2	2	2	1	–	1	2	–	2	3	2	3
CO5	3	3	2	2	3	3	2	–	1	2	–	3	3	2	3
Avg.	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**–**	**2**	**3**	**–**	**3**	**3**	**3**	**3**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix

24ME3752 **MECHATRONICS AND IoT**

L	T	P	C
2	0	2	3

COURSE OBJECTIVES

1. To apply the fundamental principles of energy generation from conventional and non-conventional energy sources.
2. To analyze the working principles, components, and performance of thermal, hydro, nuclear, and renewable power plants.
3. To evaluate different energy generation technologies based on efficiency, economics, environmental impact, and sustainability.
4. To apply the latest developments and emerging technologies in renewable and sustainable energy systems.
5. To apply engineering concepts to select appropriate energy generation methods for practical and industrial applications.

UNIT I SENSORS AND ACTUATORS 9

Introduction to Mechatronics – Systems – Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics. Sensors and Transducers: Static and Dynamic Characteristics of Sensor, Potentiometers – LVDT – Capacitance Sensors – Strain Gauges – Eddy Current Sensor – Hall Effect Sensor –Temperature Sensors – Light Sensors. Types of Stepper and Servo motors – Construction – Working Principle – Characteristics.

PRACTICAL

1. Measurement of Linear/Angular of Position, Direction and Speed using Transducers.
2. Measurement of Pressure, Temperature and Force using Transducers.

UNIT II PROGRAMMABLE LOGIC CONTROLLER AND MECHATRONICS SYSTEM DESIGN 9

Introduction – Architecture – Input / Output Processing – Programming with Timers, Counters and Internal relays – Data Handling – Selection of PLC, Stages of Mechatronics Design Process – Comparison of Traditional and Mechatronics Design Concepts with Examples – Case studies of Mechatronics Systems – Pick and Place Robot – Engine Management system – Automatic Car Park Barrier.

PRACTICAL

1. Sequencing of Hydraulic and Pneumatic circuits.
2. Sequencing of Hydraulic, Pneumatic and Electro-pneumatic circuits using Software.
3. Electro-pneumatic/hydraulic control using PLC.

UNIT III FUNDAMENTALS OF IoT AND EMBEDDED SYSTEMS 9

The Internet of Things (IoT) – Introduction to IoT Framework – IoT Enabling Technologies – The Effective Implementation of IoT – The Detailed Procedure – Embedded Systems: An Introduction – Single-Chip Microcontroller Systems – Single-Board Microcontroller Systems – Embedded System Peripherals.

PRACTICAL

1. Write a program to turn ON / OFF motor using microcontroller / SBC through internet.
2. Write a program to interface sensors to display the data on the screen through internet.

UNIT IV CONTROLLERS 9

Foundation Topics: Programming Languages: C++ and Python – The Linux Operating System – Arduino Boards: Arduino Peripherals – Arduino IDE – ESP32 Wi-Fi module – Raspberry Pi: The Raspberry Pi Boards – The Raspberry Pi Peripherals – The Raspberry Pi Operating System.

PRACTICAL

1. Interface the sensors with microcontroller/SBC and write a program to turn ON / OFF Solenoid valve through internet when sensor data is detected.
2. To interface sensor with microcontroller/SBC and write a program to turn ON / OFF Linear/Rotary Actuator through IoT when sensor data is detected.

UNIT V IoT CASE STUDIES 9

Remote Monitoring Systems- Remotely Operated Autonomous Systems - Centralized Water Management System - IoT Enabled Robotic Camera Dolly - Portable, Wireless, Interactive IoT Sensors for Agriculture - IoT Vehicle Management System with Network Selection.

PRACTICALS

1. To interface Bluetooth / Wifi with microcontroller / SBC and write a program to send sensor data to smart phone using Bluetooth / wifi.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Select suitable sensors and actuators to design and develop mechatronics systems.
2. Evaluate PLC-based control for automated systems in real-time mechatronics applications.
3. Analyze the fundamentals of IoT and embedded systems in engineering solutions.
4. Apply control of I/O devices using Arduino and Raspberry Pi for practical mechatronics applications.
5. Design and develop an IoT based system for the given real-time application.

TEXT BOOKS

1. Bradley D.A., Burd N.C., Dawson D., Loader A.J., "Mechatronics: Electronics in Products and Processes", Routledge, 2017.
2. Sami S.H and Kisheen Rao G "The Internet of Mechanical Things: The IoT Framework for Mechanical Engineers", CRC Press, 2022.

REFERENCES

1. John Billingsley, "Essentials of Mechatronics", Wiley, 2006
2. David H., Gonzalo S., Patrick G., Rob B. and Jerome H., "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", Pearson Education, 2018, Universities Press.
3. Nitin G and Sharad S, "Internet of Things: Robotic and Drone Technology", CRC Press, 2022.
4. Newton C. Braga, "Mechatronics for The Evil Genius", McGrawHill, 2005.
5. Bell C., "Beginning Sensor Networks with Arduino and Raspberry Pi", A press, 2013.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	1	1	-	1	-	2	2	3	1	2
CO2	3	3	3	3	3	1	1	-	1	-	2	2	3	1	2
CO3	3	2	2	2	3	1	1	-	1	-	2	3	3	1	2
CO4	3	2	3	2	3	1	1	-	2	-	2	3	3	1	2
CO5	3	3	3	3	3	2	2	-	2	-	2	3	3	1	2
Avg.	**3**	**2**	**3**	**2**	**3**	**1**	**1**	-	**1**	-	**2**	**3**	**3**	**1**	**2**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix

24TP3701 **SKILL ENHANCEMENT – VII**

L	T	P	C
0	**0**	**2**	**1**

COURSE OBJECTIVES

1. Provide a basic understanding of mechanical engineering fundamentals.
2. Provide a basic understanding of mechanical engineering concept with their real-time applications.
3. Develop the ability to collect, review, and analyze technical literature for project work.
4. Enhance students' skills in identifying engineering problems and understanding professional practices.
5. Improve technical communication through case study analysis and seminar presentations.

UNIT I OVERVIEW OF MECHANICAL ENGINEERING CONCEPTS 6

Applied Mechanics and Design - Fluid Mechanics and Thermal Sciences - Materials, Manufacturing and Industrial Engineering.

Activity: Multiple Choice Question Patterns

UNIT II ENGINEERING IN REAL-TIME APPLICATIONS 6

Engineering concepts – real-life and industrial problems – Real-time examples –Industry – academia relevance.

UNIT III LITERATURE SURVEY AND INFORMATION GATHERING 6

Identification of project domain – Literature survey methodology – Sources of technical information: journals, conference papers, patents, standards, reports, and theses – Use of digital libraries and research databases – Keyword selection, citation, and referencing – Research ethics and plagiarism awareness.

UNIT IV CASE STUDIES 6

Case studies related to mechanical engineering projects and emerging technologies – Analysis of successful engineering solutions – Problem identification, solution approach, and Expected outcomes – Presentation and discussion of case studies – continuous improvement.

UNIT V TECHNICAL PRESENTATION AND SEMINAR DELIVERY 6

Structure of technical seminars – Preparation of effective presentation slides – Technical storytelling and logical flow – Presentation skills and body language – Handling questions, peer discussions, and feedback – Seminar on literature review and recent technological advancements.

TOTAL: 30 PERIODS

COURSE OUTCOMES

Upon completion of this course, students will be able to:

1. Recall fundamental mechanical engineering concepts.
2. Relate fundamental mechanical engineering concepts to practical applications.
3. Conduct a structured literature survey using reliable technical sources.
4. Analyze engineering case studies and understand real-world problem-solving approaches.
5. Communicate technical ideas clearly through effective presentations and discussions.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	3	1	-	-	-	1	2	-	2	2	2	-
CO2	2	2	3	2	1	-	-	-	1	2	-	2	3	2	-
CO3	1	1	2	1	2	-	-	-	3	3	-	1	1	1	-

CO4	2	3	2	3	1	-	-	-	1	2	-	2	2	2	-
CO5	1	2	2	2	1	-	-	-	2	3	-	2	1	1	-
Avg.	**2**	**2**	**2**	**2**	**1**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**2**	**2**	**-**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix

24ME3811 **PROJECT WORK / INTERNSHIP**

L	T	P	C
0	0	16	8

COURSE OBJECTIVES

1. To identify, analyze, and plan appropriate methods to solve real-world engineering problems.
2. To apply engineering knowledge through practical exposure in industrial training or project-based work.
3. To design, experiment, fabricate, or analyze engineering systems to meet specified requirements.
4. To apply and demonstrate teamwork, communication, and project management skills in collaborative project environments.
5. To create and present comprehensive project reports and effectively communicate technical outcomes.

This course is to develop their project work to solve a specific problem right from its identification and literature review till the successful solution of the same, and to train the students in preparing project reports and to face reviews and viva voce examination. The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor.

Students must convert their internship work into a technical project by identifying a problem, analysing data, proposing a solution, or demonstrating engineering outcomes. The students in a group or individual for the works on a topic approved by the head of the department under the guidance of a faculty member. The final Internship Project Report must include introduction, industry profile, problem studied, methodology, results, findings, and conclusions.

The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 300 PERIODS

COURSE OUTCOMES

At the end of this course, students will be able to

1. Plan appropriate methods to solve a practical engineering problem.
2. Apply engineering knowledge and tools to create or test a model, system, or prototype.
3. Work effectively in real industrial or project environments to solve engineering problems.
4. Work as a team member or leader by showing good communication, coordination, and professionalism.
5. Prepare a clear project report and present the project work confidently during reviews and viva-voce.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	2	2	1	1	2	2	3	3	2	2	2	2
CO2	3	3	3	3	3	1	1	2	1	2	2	2	3	3	3
CO3	2	2	2	2	2	1	1	3	2	3	3	2	2	2	3
CO4	1	1	1	1	1	1	1	3	3	3	3	2	1	1	3
CO5	1	2	1	1	2	1	1	2	3	3	2	2	1	1	3
Avg.	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix

VERTICAL 1: THERMAL ENGINEERING

24ME3011 **FUELS AND COMBUSTION**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. To understand the properties, testing methods, and characterization techniques of solid, liquid, and gaseous fuels.
2. To study different types of solid and liquid fuels, their properties, preparation, storage, and applications.
3. To understand the formation, properties, calorific values, and industrial applications of different gaseous fuels.
4. To study combustion chemistry, stoichiometry, ignition, flame propagation, and thermochemical calculations.
5. To understand the working principles and design considerations of combustion equipment used for solid, liquid, and gaseous fuels.

UNIT I CHARACTERIZATION 8

Fuels - Types and Characteristics of Fuels - Determination of Properties of Fuels - Fuels Analysis - Proximate and Ultimate Analysis - Moisture Determination - Calorific Value - Gross & Net Calorific Values - Calorimetry - Dulong's Formula for CV Estimation - Flue gas Analysis – Orsat Apparatus - Fuel & Ash Storage & Handling - Spontaneous Ignition Temperatures.

UNIT II SOLID AND LIQUID FUELS 10

Solid Fuels Types - Coal Family - Properties - Calorific Value - ROM, DMMF, DAF and Bone-Dry Basis - Ranking - Bulk & Apparent Density - Storage - Washability - Coking & Caking Coals – Renewable Solid Fuels - Biomass - Wood Waste - Agro Fuels - Manufactured Solid Fuels. Liquid Fuels Types - Sources - Petroleum Fractions - Classification - Refining - Properties of Liquid Fuels - Calorific Value, Specific Gravity, Flash & Fire Point, Octane Number, Cetane Number etc, - Alcohols - Tar Sand Oil - Liquefaction of Solid Fuels.

UNIT III GASEOUS FUEL 7

Gaseous Fuel Classification - Composition & Properties - Estimation of Calorific Value – Gas Calorimeter. Rich & Lean Gas - Wobbe Index - Natural Gas - Dry & Wet Natural Gas – Stripped NG - Foul & Sweet NG - LPG - LNG - CNG - Methane - Producer Gas - Gasifiers - Water Gas - Town Gas - Coal Gasification - Gasification Efficiency - Non - Thermal Route - Biogas – Digesters - Reactions - Viability - Economics.

UNIT IV COMBUSTION: STOICHIOMETRY & KINETICS 12

Stoichiometry – Mass Basis & Volume Basis – Excess Air Calculation – Fuel & Flue Gas Compositions - Calculations – Rapid Methods – Combustion Processes – Stationary Flame – Surface or Flameless Combustion – Submerged Combustion – Pulsating & Slow Combustion Explosive Combustion. Mechanism of Combustion – Ignition & Ignition Energy –

Spontaneous Combustion – Flame Propagation – Solid, Liquid & Gaseous Fuels Combustion – Flame Temperature – Theoretical, Adiabatic & Actual – Ignition Limits – Limits of Inflammability. Thermo-Chemistry - Equilibrium combustion products. Low temperature combustion products – High temperature combustion products.

UNIT V COMBUSTION EQUIPMENTS 8

Coal Burning Equipments – Types – Pulverized Coal Firing – Fluidized Bed Firing – Fixed Bed & Recycled Bed – Cyclone Firing – Spreader Stokers – Vibrating Grate Stokers – Sprinkler Stokers, Traveling Grate Stokers. Oil Burners – Vaporizing Burners, Atomizing Burners – Design of Burners. Gas Burners – Atmospheric Gas Burners – Air Aspiration Gas Burners – Burners Classification according to Flame Structures – Factors Affecting Burners & Combustion.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Explain and evaluate fuel properties, calorific values, proximate and ultimate analysis, and flue gas analysis.
2. Compare various solid and liquid fuels, interpret their characteristics, and determine their suitability for different engineering applications.
3. Classify gaseous fuels, estimate calorific values, and analyze gasifier performance and biogas production.
4. Carry out combustion calculations, analyze flame characteristics, determine temperature limits, and interpret ignition behaviour for various fuels
5. Explain the types, construction, and performance of burners, stokers, fluidized bed systems, and other combustion equipment.

TEXT BOOKS

1. Samir Sarkar, Fuels & Combustion, 2nd Edition, Orient Longman, 1990.
2. Sharma SP., Mohan Chander, Fuels & Combustion, Tata Mcgraw Hill, 1984

REFERENCES

1. B.I. Bhatt and S.M. Vora, Stoichiometry, 2nd Edition, Tata Mcgraw Hill, 1984.
2. Blokh A.G., Heat Transfer in Steam Boiler Furnace, Hemisphere Publishing Corpn, 1988.
3. Civil Davies, Calculations in Furnace Technology, Pergamon Press, Oxford, 1966.
4. Holman J.P., Thermodynamics, Fourth Edition, McGraw-Hill Inc., 1988.
5. Yunus A. Cengel and Michael A. Boles, Thermodynamics, McGraw-Hill Inc., 2006.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	1	2	1	1	1	1	2	2	2	1
CO2	3	3	1	2	2	2	3	1	1	1	1	2	2	2	2
CO3	3	3	2	3	2	1	2	1	1	1	1	3	3	3	2
CO4	2	3	2	2	2	3	3	1	1	1	1	2	3	3	2
CO5	2	2	2	2	3	2	2	1	1	1	1	2	3	3	3
Avg.	**3**	**3**	**2**	**3**	**2**	**2**	**3**	**1**	**1**	**1**	**1**	**2**	**3**	**3**	**2**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3012 **TURBO MACHINES**

L	T	P	C
3	**0**	**0**	**3**

COURSE OBJECTIVES

1. To study the energy transfer in rotor and stator parts of the turbo machines.
2. To study the function of various elements of centrifugal fans and blowers.
3. To evaluating the working and performance of centrifugal compressor
4. To analyzing flow behavior and flow losses in axial flow compressor.
5. To study the types and working of axial and radial flow turbines.

UNIT I WORKING PRINCIPLES 9

Classification of Turbomachines. Energy transfer between fluid and rotor - Euler equation and its interpretation. Velocity triangles. Efficiencies in Compressor and Turbine stages. Degree of reaction. Dimensionless parameters for Turbomachines.

UNIT II CENTRIFUGAL FANS AND BLOWERS 9

Types – components – working. Flow analysis in impeller blades-volute and diffusers. Velocity triangles – h-s diagram. Stage parameters in fans and blowers. Performance characteristic curves – various losses. Fan – bearings, drives and noise.

UNIT III CENTRIFUGAL COMPRESSOR 9

Components - blade types. Velocity triangles - h-s diagram, stage work. Slip factor and Degree of Reaction. Performance characteristics and various losses. Geometry and performance calculation.

UNIT IV AXIAL FLOW COMPRESSOR 9

Construction details. Work done factor. Velocity triangles - h-s diagram, stage work. Work done factor. Performance characteristics, efficiency and stage losses – Stalling and Surging. Free and Forced vortex flow.

UNIT V AXIAL AND RADIAL FLOW TURBINES 9

Axial flow turbines - Types – Elements - Stage velocity diagrams - h-s diagram, stage work - impulse and reaction stages. Compounding of turbines. Performance coefficients and losses. Radial flow turbines: Types – Elements - Stage velocity diagrams - h-s diagram, stage work Performance coefficients and losses.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Explain the energy transfer in rotor and stator parts of the turbo machines.
2. Explain the function of various elements of centrifugal fans and blowers
3. Evaluate the working and performance of centrifugal compressor.
4. Analyze flow behavior and flow losses in axial flow compressor.
5. Explain the types and working of axial and radial flow turbines

TEXT BOOKS

1. Ganesan, V., “Gas Turbines”, 3rd Edition, Tata McGraw Hill, 2011. .
2. Yahya, S.M., “Turbines, Compressor and Fans”, 4th Edition, Tata McGraw Hill, 2011.

REFERENCES

1. Dixon, S.L., “Fluid Mechanics and Thermodynamics of Turbomachinery”, 7th Edition, Butterworth Heinemann, 2014.
2. Gopalakrishnan. G and Prithvi Raj. D,” A Treatise on Turbomachines”, Scitech Publications (India) Pvt. Ltd., 2nd Edition, 2008.
3. Lewis, R.I., “Turbomachinery Performance Analysis” 1st Edition, Arnold Publisher, 1996.
4. Saravanamutto, Rogers, Cohen, Straznicky., “Gas Turbine Theory” 6th Edition, Pearson Education Ltd, 2009.
5. Venkanna, B.K., “Fundamentals of Turbomachinery”, PHI Learning Pvt. Ltd., 2009.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	-	-	-	-	1	-	-	1	3	2	1
CO2	2	1	1	1	-	-	-	-	1	-	-	1	3	2	1
CO3	2	1	1	1	-	-	-	-	1	-	-	1	3	2	1
CO4	2	1	1	1	-	-	-	-	1	-	-	1	3	2	1
CO5	2	1	1	1	-	-	-	-	1	-	-	1	3	2	1
Avg.	2	1	1	1	-	-	-	-	1	-	-	1	3	2	1

“1” - low, “2” - medium, “3” - high, “-” - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3013 ENERGY GENERATION TECHNOLOGIES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. To study the coal based thermal power plants.
2. To study the diesel, gas turbine and combined cycle power plants.
3. To learn the basic of nuclear engineering and power plants.
4. To understand the principles, construction, and working of various non-solar renewable energy systems and their role in sustainable power generation.
5. To study the fundamentals of solar energy and solar energy systems in achieving clean and affordable energy goals.

UNIT I TARIFF AND COAL BASED THERMAL POWER PLANTS 9

Power tariff types, Load distribution parameters, load curve - Rankine cycle, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Subsystems of thermal power plants. Binary Cycles and Cogeneration systems. Environmental issue.

UNIT II DIESEL, GAS AND COMBINED CYCLE POWER PLANTS 9

Recap of Basic concepts – Components of Diesel and Gas Turbine power plants – Working principle. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.

UNIT III NUCLEAR POWER PLANTS 9

Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors: Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada Deuterium- Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures and environmental issues for Nuclear Power plants.

UNIT IV SOLAR ENERGY SYSTEMS 9

Introduction to Solar Energy-SDG Goals-Solar Radiation and Measurement-Solar Photo Voltaic (SPV). Solar Thermal - flat plate collectors, evacuated tube collectors, and concentrating type solar systems (parabolic trough, parabolic dish, solar tower, and Fresnel concentrator).

UNIT V OTHER RENWABLE ENERGY SYSTEMS 9

Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, Geo Thermal, Biogas and Fuel Cell power systems.

TOTAL :45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Explain the layout, construction and working of the components inside a thermal power plant.

2. Explain the layout, construction and working of the components inside a Diesel, Gas and Combined cycle power plants.
3. Explain the layout, construction and working of the components inside nuclear power plants.
4. Explain the operation and components of hydro, wind, tidal, geothermal, biogas, and fuel cell power systems for clean energy production.
5. Explain the principles, components, and working of various solar energy systems used for clean and affordable power generation.

TEXT BOOKS

1. Nag. P.K., "Power Plant Engineering", Third Edition, Tata McGraw – Hill Publishing Company Ltd., 2008.
2. A Textbook of Power Plant Engineering by R.K. Rajput 1 January 2016

REFERENCES

1. El-Wakil. M.M., "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd., 2010.
2. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.
3. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw – Hill, 1998.
4. Power Plant Engineering by B. Vijaya Ramnath C. Elanchezhian, L. Saravanakumar 1 November 2019
5. Power Plant Engineering, As per AICTE: Theory and Practice by Dipak Kumar Mandal, Somnath Chakrabarti, et al. 1 January 2019

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	–	–	–	2	–	–	2	–	2	2	2	1
CO2	3	3	2	1	–	–	2	–	–	2	–	2	3	2	2
CO3	3	3	3	1	1	–	2	1	–	2	–	2	3	2	2
CO4	3	3	3	2	1	–	3	2	–	3	–	3	3	3	3
CO5	2	2	2	1	2	–	2	2	–	2	–	2	2	2	2
Avg.	**3**	**3**	**2**	**1**	**1**	**–**	**2**	**1**	**–**	**2**	**–**	**2**	**3**	**2**	**2**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3014 **ENGINE AND VEHICLE TECHNOLOGY**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. To study the advanced engine technologies
2. To learn various advanced combustion technologies and its benefits
3. To learn the methods of using low carbon fuels and its significance
4. To learn and understand the hybrid and electric vehicle configurations
5. To study the application of fuel cell technology in automotives

UNIT I ADVANCED ENGINE TECHNOLOGY 9

Gasoline Direct Injection, Common Rail Direct Injection, Variable Compression Ratio Turbocharged Engines, Electric Turbochargers, VVT, Intelligent Cylinder De-activation, After Treatment Technologies, Electric EGR, Current EMS architecture.

UNIT II COMBUSTION TECHNOLOGY 9

Spark Ignition combustion, Compression Ignition Combustion, Conventional Dual Fuel Combustion, Low Temperature Combustion Concepts – Controlled Auto Ignition, Homogeneous Charge Compression Ignition, Premixed Charge Compression Ignition, Partially Premixed Compression Ignition, Reactivity Controlled Compression Ignition, Gasoline Direct Injection Compression Ignition.

UNIT III ALTERNATE FUEL TECHNOLOGY 9

Alcohol Fuels, Ammonia Fuel and Combustion, Methane Technology, Dimethyl Ether, Hydrogen Fuel Technology, Challenges, and way forward

UNIT IV HYBRID AND ELECTRIC VEHICLE TECHNOLOGY 9

Conventional Hybrids (Conventional ICE + Battery), Modern Hybrids (RCCI/GDCI Engine + Battery), Pure Electric Vehicle Technology – Challenges and Way forward

UNIT V FUEL CELL TECHNOLOGY 9

Fuel cells for automotive applications - Technology advances in fuel cell vehicle systems – Onboard hydrogen storage - Liquid hydrogen and compressed hydrogen - Metal hydrides, Fuel cell control system - Alkaline fuel cell - Road map to market.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Discuss the latest trends in engine technology
2. Discuss the need of advanced combustion technologies and its impact on reducing carbon foot-print on the environment.

3. Analyzing the basic characteristics of low carbon fuels, its impact over conventional fuels and in achieving sustainable development goals.
4. Discuss the working and energy flow in various hybrid and electric configurations.
5. Analyzing the need for fuel cell technology in automotive applications.

TEXT BOOKS

1. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
2. Rakesh Kumar Maurya, Characteristics and Control of Low Temperature Combustion Engines. ISBN 978-3-319-68507-6, Springer

REFERENCES

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003
3. Rand D.A.J, Woods, R & Dell RM Batteries for Electric vehicles, John Wiley & Sons, 1998
4. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
5. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	–	–	1	–	–	1	–	2	3	2	1
CO2	3	3	2	2	1	–	2	–	–	2	–	2	3	3	2
CO3	3	3	2	1	1	–	2	–	–	2	–	2	3	3	2
CO4	3	3	3	2	1	–	3	1	1	2	–	3	3	3	3
CO5	3	2	2	1	1	–	2	2	–	2	–	2	3	3	2
Avg.	**3**	**3**	**2**	**1**	**1**	**–**	**2**	**1**	**1**	**2**	**–**	**2**	**3**	**3**	**2**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3015 **ADVANCED INTERNAL COMBUSTION ENGINEERING**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. To study the working of Gasoline fuel injection systems and SI combustion.
2. To study the working of Diesel fuel injection systems and CI combustion.
3. To Identifying the source and measure it; explain the mechanism of emission formation and control methods.
4. To study the Selecting alternative fuel resources and its utilization techniques in IC engines.
5. To study the advanced combustion modes and future power train systems.

UNIT I SPARK IGNITION ENGINES 9

Mixture requirements – Fuel injection systems – Mono-point, Multipoint & Direct injection - Stages of combustion – Normal and Abnormal combustion, Spark Knock, Factors affecting knock, Combustion chambers.

UNIT II COMPRESSION IGNITION ENGINES 9

Diesel Fuel Injection Systems – Mechanical and Common Rail Direct Injection Systems - Stages of combustion – Knocking – Factors affecting knock –Direct and Indirect injection systems –Fuel Spray behaviour – Spray structure and spray penetration – Air motion - Combustion chambers – Turbo charging – Waste Gate, Variable Geometry turbochargers.

UNIT III EMISSION FORMATION AND CONTROL 9

Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides of Nitrogen, Smoke and Particulate matter – Methods of controlling emissions – In-cylinder treatments – After treatment systems – Three Way Catalytic converter, Selective Catalytic Reduction, De-NO_x Catalyst, Diesel Oxidation Catalyst and Particulate Traps – Methods of emission measurement – Emission norms and Driving cycles.

UNIT IV ALTERNATE FUELS 9

Alcohol Fuels, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel -Properties, Suitability, Merits and Demerits – Utilisation Methods - Engine Modifications.

UNIT V ALTERNATE COMBUSTION AND POWER TRAIN SYSTEM 9

Low Temperature Combustion - Homogeneous charge compression ignition (HCCI) – Reactivity Controlled Compression Ignition (RCCI) – Gasoline Compression Ignition – Spark Assisted HCCI - Hybrid Electric and Electric Vehicles –- Fuel Cells.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Explain the working of Gasoline fuel injection systems and SI combustion.
2. Explain the working of Diesel fuel injection systems and CI combustion.
3. Identify the source and measure it; explain the mechanism of emission formation and control methods.
4. Select alternative fuel resources and its utilization techniques in IC engines.
5. Explain advanced combustion modes and future power train systems.

TEXT BOOKS

1. V. Ganesan, “Internal Combustion Engines”, V Edition, Tata McGraw Hill, 2012.
2. John B. Heywood, “Internal Combustion Engines Fundamentals”, McGraw-Hill, 1988.

REFERENCES

1. B.P. Pundir, "IC Engines Combustion & Emission", Narosa Publishing House, 2014.
2. Duffy Smith, "Auto Fuel Systems", The Good Heart Wilcox Company, Inc., 2003.
3. EranSher, Handbook of Air Pollution from Internal Combustion Engines: Pollutant Formation and Control, Academic Press, 1998.
4. K.K. Ramalingam, "Internal Combustion Engine Fundamentals", SciTech Publications, 2011.
5. R.B. Mathur and R.P. Sharma, "Internal Combustion Engines", Dhanpat Rai& Sons, 2007

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	–	–	1	–	–	1	–	2	3	2	1
CO2	3	3	2	2	–	–	2	–	–	2	–	2	3	3	2
CO3	3	3	3	2	1	2	2	1	–	2	–	3	3	3	2
CO4	3	3	3	1	1	–	2	–	–	2	–	2	3	3	2
CO5	3	3	3	2	1	–	2	1	–	2	–	3	3	3	2
Avg.	**3**	**3**	**3**	**2**	**1**	**1**	**2**	**1**	**–**	**2**	**–**	**2**	**3**	**3**	**2**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3016 REFRIGERATION AND AIR CONDITIONING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. To introduce the underlying principles of operations in different Refrigeration & Air conditioning systems and components.
2. To provide knowledge on design aspects of Refrigeration & Air conditioning systems.
3. To study other refrigeration systems.
4. To learn the psychrometric properties and processes.
5. To study the air conditioning systems and load estimation.

UNIT I INTRODUCTION 6

Introduction to Refrigeration - Unit of Refrigeration and C.O.P.– Ideal cycles- Refrigerants Desirable properties – Classification - Nomenclature - ODP & GWP.

UNIT II VAPOUR COMPRESSION REFRIGERATION SYSTEM 9

Vapor compression cycle: p-h and T-s diagrams - deviations from theoretical cycle – subcooling and super heating- effects of condenser and evaporator pressure on COP- multi-pressure system - low temperature refrigeration - Cascade systems – problems. Equipment: Type of Compressors, Condensers, Expansion devices, Evaporators.

UNIT III OTHER REFRIGERATION SYSTEMS 9

Working principles of Vapour absorption systems and adsorption cooling systems – Steam jet refrigeration- Ejector refrigeration systems- Thermoelectric refrigeration- Air refrigeration – Magnetic - Vortex and Pulse tube refrigeration systems.

UNIT IV PSYCHROMETRIC PROPERTIES AND PROCESSES 9

Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temperature Thermodynamic wet bulb temperature, Psychrometric chart; Psychrometric of air-conditioning processes, mixing of air streams

UNIT V AIR CONDITIONING SYSTEMS AND LOAD ESTIMATION 12

Air conditioning loads: Outside and inside design conditions; Heat transfer through structure, Solar radiation, Electrical appliances, Infiltration and ventilation, internal heat load; Apparatus selection; fresh air load, human comfort & IAQ principles, effective temperature & chart, calculation of summer & winter air conditioning load; Classifications, Layout of plants; Air distribution system; Filters; Air Conditioning Systems with Controls: Temperature, Pressure and Humidity sensors, Actuators & Safety controls.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Explain the basic concepts of Refrigeration.
2. Explain the Vapor compression Refrigeration systems and to solve problems.
3. Discuss the various types of Refrigeration systems.
4. Calculate the Psychrometric properties and its use in psychrometric processes.
5. Explain the concepts of Air conditioning and to solve problems.

TEXT BOOKS

1. Arora, C.P., "Refrigeration and Air Conditioning", 3rd edition, McGraw Hill, New Delhi, 2010.
2. Textbook of Refrigeration and Air-Conditioning (M.E.) by R.S. Khurmi | 10 February 2019.

REFERENCES

1. ASHRAE Hand book, Fundamentals, 2010.
2. Jones W.P., "Air conditioning engineering", 5th edition, Elsevier Butterworth-Heinemann, 2007.
3. Roy J. Dossat, "Principles of Refrigeration", 4th edition, Pearson Education Asia, 2009.
4. Stoecker, W.F. and Jones J.W., "Refrigeration and Air Conditioning", McGraw Hill, New Delhi,1986.
5. A Textbook of Refrigeration and Air-Conditioning by R.K. Rajput | 1 January 2013.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	-	1	2	-	1	1	2	2	3	2	2
CO2	3	3	3	2	-	1	2	-	2	2	2	3	3	2	2
CO3	3	3	3	2	-	1	2	-	2	2	3	3	3	2	2
CO4	3	3	3	2	-	1	2	-	2	2	3	3	3	2	2
CO5	3	3	3	2	-	1	2	1	2	2	3	3	3	2	2
Avg.	**3**	**3**	**3**	**2**	**-**	**1**	**2**	**1**	**2**	**2**	**3**	**3**	**3**	**2**	**2**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3017 GAS DYNAMICS AND JET PROPULSION

L	T	P	C
3	**0**	**0**	**3**

COURSE OBJECTIVES

1. To study the fundamentals of compressible flow concepts and the use of gas tables.
2. To learn the compressible flow behaviour in constant area ducts.
3. To study the development of shock waves and its effects.
4. To study the types of jet engines and their performance parameters.
5. To learn the types of rocket engines and their performance parameters.

UNIT I BASIC CONCEPTS AND ISENTROPIC FLOWS 9

Energy and momentum equations of compressible fluid flows, Concepts of compressible flow – Mach waves and Mach cone. Flow regimes, effect of Mach number on compressibility. Stagnation, static, critical properties and their interrelationship. Isentropic flow and its relations. Isentropic flow through variable area ducts – nozzles and diffusers. Use of Gas tables.

UNIT II COMPRESSIBLE FLOW THROUGH DUCTS 9

Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – variation of flow properties. Choking. Isothermal flow with friction. Use of Gas tables.

UNIT III NORMAL AND OBLIQUE SHOCKS 9

Governing equations - Rankine-Hugoniot Relation. Variation of flow parameters across the normal and oblique shocks. Prandtl – Meyer expansion and relation. Use of Gas tables.

UNIT IV JET PROPULSION 9

Theory of jet propulsion – thrust equation – Performance parameters - thrust, power and efficiency. Operation, cycle analysis and performance of ram jet, turbojet, turbofan, turbo prop and pulse jet engines.

UNIT V SPACE PROPULSION 9

Types of rocket engines and propellants. Characteristic velocity – thrust equation. Theory of single and multistage rocket propulsion. Liquid fuel feeding systems. Solid propellant geometries. Orbital and escape velocity. Rocket performance calculations.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Apply the fundamentals of compressible flow concepts and the use of gas tables.
2. Analyze the compressible flow behaviour in constant area ducts.
3. Analyze the development of shock waves and its effects.
4. Explain the types of jet engines and their performance parameters.
5. Explain the types of rocket engines and their performance parameters.

TEXT BOOKS

1. Anderson, J.D., "Modern Compressible flow", Third Edition, McGraw Hill, 2003.
2. S.M. Yahya, "Fundamentals of Compressible Flow with Aircraft and Rocket propulsion", New Age International (P) Limited, 4th Edition, 2012.

REFERENCES

1. R. D. Zucker and O Biblarz, "Fundamentals of Gas Dynamics", 2nd edition, Wiley, 2011.
2. Balachandran, P., "Fundamentals of Compressible Fluid Dynamics", Prentice-Hall of India, 2007.
3. Radhakrishnan, E., "Gas Dynamics", Printice Hall of India, 2006.
4. Hill and Peterson, "Mechanics and Thermodynamics of Propulsion", Addison – Wesley, 1965.
5. Babu, V., "Fundamentals of Compressible Flow", CRC Press, 1st Edition, 2008.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	–	–	1	–	–	1	–	2	3	2	1
CO2	3	3	3	1	–	–	1	–	–	1	–	2	3	2	1
CO3	3	3	3	2	–	–	1	–	–	1	–	2	3	2	1
CO4	3	3	2	2	1	–	2	–	1	2	–	3	3	3	2
CO5	3	2	2	2	1	–	2	–	1	2	–	3	3	3	2

Avg.	**3**	**3**	**2**	**2**	**1**	–	**1**	–	**1**	**1**	–	**2**	**3**	**2**	**1**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3018 COMPUTATIONAL FLUID DYNAMICS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. To understand the governing equations of fluid dynamics and boundary conditions used in CFD.
2. To learn finite difference and finite volume formulations for diffusion-type problems.
3. To study discretization schemes for convection-diffusion problems and analyze their properties.
4. To apply numerical methods to flow field analysis including pressure-velocity coupling algorithms.
5. To explore turbulence modeling, mesh generation techniques, and CFD software tools.

UNIT I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS 9

Basics of computational fluid dynamics – Governing equations of fluid dynamics – Continuity, Momentum and Energy equations – Chemical species transport – Physical boundary conditions – Time-averaged equations for Turbulent Flow – Turbulent–Kinetic Energy Equations – Mathematical behaviour of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations.

UNIT II FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR DIFFUSION 9

Derivation of finite difference equations – Simple Methods – General Methods for first and second order accuracy – Finite volume formulation for steady state One, Two and Three - dimensional diffusion problems –Parabolic equations – Explicit and Implicit schemes – Example problems on elliptic and parabolic equations – Use of Finite Difference and Finite Volume methods.

UNIT III FINITE VOLUME METHOD FOR CONVECTION DIFFUSION 9

Steady one-dimensional convection and diffusion – Central, upwind differencing schemes properties of discretization schemes – Conservativeness, Boundedness, Transportiveness, Hybrid, Power-law, QUICK Schemes.

UNIT IV FLOW FIELD ANALYSIS 9

Finite volume methods -Representation of the pressure gradient term and continuity equation – Staggered grid – Momentum equations – Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants – PISO Algorithms.

UNIT V TURBULENCE MODELS AND MESH GENERATION 9

Turbulence models, mixing length model, Two equation (k-Є) models – High and low Reynolds number models – Structured Grid generation – Unstructured Grid generation – Mesh refinement – Adaptive mesh – Software tools.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Formulate governing equations of fluid flow (continuity, momentum, energy, turbulence) and classify PDEs relevant to CFD.
2. Apply finite difference and finite volume methods for solving 1D, 2D, and 3D diffusion problems with suitable schemes.
3. Analyze discretization methods for convection-diffusion problems and select appropriate schemes (upwind, hybrid, QUICK, etc.).
4. Implement pressure-velocity coupling algorithms (SIMPLE, PISO) to analyze flow fields using finite volume methods.
5. Evaluate turbulence models and apply structured/unstructured mesh generation with refinement techniques in CFD simulations.

TEXT BOOKS

1. Ghoshdastidar, P.S., "Computer Simulation of flow and heat transfer", Tata McGraw Hill Publishing Company Ltd., 2017.
2. Versteeg, H.K., and Malalasekera, W., "An Introduction to Computational Fluid Dynamics: The finite volume Method", Pearson Education Ltd.Second Edition, 2007.

REFERENCES

1. Anil W. Date "Introduction to Computational Fluid Dynamics" Cambridge University Press, 2005.
2. Chung, T.J. "Computational Fluid Dynamics", Cambridge University, Press, 2002. 3. Ghoshdastidar P.S., "Heat Transfer", Oxford University Press, 2005
3. Muralidhar, K., and Sundararajan, T., "Computational Fluid Flow and Heat Transfer", Narosa
4. Publishing House, New Delhi, 2014. 5. Patankar, S.V. "Numerical Heat Transfer and Fluid Flow", Hemisphere Publishing Corporation, 2004

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	–	–	1	–	–	1	–	2	3	2	1
CO2	3	3	3	2	–	–	2	–	–	2	–	2	3	3	2
CO3	3	3	3	2	–	–	2	–	–	2	–	2	3	3	2
CO4	3	3	3	3	1	–	2	–	–	2	–	3	3	3	3

CO5	3	2	2	1	1	–	2	1	–	2	–	2	3	3	2
Avg.	**3**	**3**	**3**	**2**	**1**	**–**	**2**	**1**	**–**	**2**	**–**	**2**	**3**	**3**	**2**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

VERTICAL 2: MANUFACTURING ENGINEERING

24ME3021 WELDING ENGINEERING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. Apply knowledge of welding processes and classifications to select appropriate welding methods for specific engineering applications.
2. Analyze the effects of welding metallurgy and heat-affected zones on microstructural changes and material properties.
3. Apply arc welding principles to operate equipment and adjust process parameters for given welding requirements.
4. Analyze resistance welding and advanced welding processes by comparing techniques, inspection methods, and quality outcomes.
5. Apply weld design principles, safety practices, and relevant standards to analyze the suitability of welding automation and emerging technologies in industrial applications.

UNIT I INTRODUCTION TO WELDING ENGINEERING 9

Welding: Definition, Scope and Applications in Mechanical Engineering – Classification of Welding Processes: Fusion and Solid-State Welding – Overview of Arc Welding, Gas Welding, Resistance Welding, Electron Beam and Laser Beam Welding – Selection Criteria of Welding Processes – Advantages, Limitations and Applications.

UNIT II METALLURGY OF WELDING 9

Fundamentals of Welding Metallurgy – Heat Affected Zone (HAZ), Fusion Zone, Base Metal – Microstructural Changes during Welding – Solidification and Grain Structure – Residual Stresses and Distortion – Methods of Minimizing Residual Stress – Weldability of Ferrous and Non-Ferrous Metal.

UNIT III ARC WELDING PROCESSES AND EQUIPMENT 9

Shielded Metal Arc Welding (SMAW) – Gas Metal Arc Welding (GMAW/MIG) – Flux Cored Arc Welding (FCAW) – Gas Tungsten Arc Welding (GTAW/TIG) – Submerged Arc Welding (SAW) – Welding Power Sources: Transformers, Rectifiers, Inverters – Welding Parameters: Current, Voltage, Polarity, Travel Speed.

UNIT IV RESISTANCE AND ADVANCED WELDING PROCESSES 9

Resistance Welding: Spot, Seam, Projection, and Flash Welding – Equipment, Parameters, Applications – Advanced Welding Techniques: Electron Beam Welding (EBW), Laser Beam Welding (LBW), Friction Stir Welding (FSW), Ultrasonic Welding – Automation in Welding – Weld Quality Inspection and Non-Destructive Testing (NDT).

UNIT V WELD DESIGN, SAFETY AND FUTURE TRENDS 9

Weld Design: Fillet, Butt, Groove Welds, Symbols, and Standards (AWS / IS) – Welding Codes and Standards – Welding Defects and Remedies – Safety in Welding: PPE, Ventilation, Fire Prevention – Emerging Trends: Robotic Welding, Additive Manufacturing and Hybrid Welding Processes – Case Studies in Automotive, Aerospace, and Heavy Engineering Industries.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Analyze welding processes to select appropriate methods based on applications and selection criteria.
2. Analyze welding metallurgy, heat-affected zone (HAZ) behavior, microstructural changes, and material weldability.
3. Apply and analyze arc welding processes by selecting suitable equipment and welding parameters for given requirements.
4. Apply and analyze resistance and advanced welding processes and assess weld quality using non-destructive testing (NDT) methods.
5. Apply and analyze weld design principles to identify defects, ensure safety compliance, and examine modern trends such as robotic and hybrid welding

TEXT BOOKS

1. R.S. Parmar, Welding Engineering and Technology, Khanna Publishers.
2. P.N. Rao, Welding Technology, Tata McGraw-Hill.

REFERENCES

1. John C. Lippold, Welding Metallurgy and Weldability, Wiley.
2. Kenneth Easterling, Introduction to Welding Science and Technology, Butterworth-Heinemann
3. Dr. O.P. Khanna, A Textbook of Welding Technology, Dhanpat Rai & Sons

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	1	1	1	1	2	1	2	3	2	2
CO2	3	3	2	2	2	1	1	1	1	2	1	3	3	2	2
CO3	3	2	3	1	3	1	1	1	1	2	1	2	3	3	2
CO4	3	2	3	2	3	1	1	1	1	2	1	3	3	3	3
CO5	3	2	3	2	3	2	2	1	2	3	2	3	3	3	3
Avg.	**3**	**2**	**3**	**2**	**3**	**1**	**1**	**1**	**1**	**2**	**1**	**3**	**3**	**3**	**2**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3022 **ADDITIVE MANUFACTURING**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. Analyze the development of Additive Manufacturing (AM) technologies to assess business opportunities and engineering applications.
2. Apply AM software tools, processes, and techniques to develop physical prototypes that meet product development requirements.
3. Analyze vat polymerization and direct energy deposition processes based on material behaviour, process parameters, and application suitability.
4. Analyze powder bed fusion and material extrusion processes by comparing capabilities, limitations, and performance outcomes.
5. Evaluate binder jetting, material jetting, and sheet lamination processes to determine their applicability for specific manufacturing scenarios.

UNIT I INTRODUCTION 9

Overview - Need - Development of Additive Manufacturing (AM) Technology: Rapid Prototyping- Rapid Tooling - Rapid Manufacturing - Additive Manufacturing. AM Process Chain- ASTM/ISO 52900 Classification - Benefits. Applications: Building Printing - Bio Printing - Food Printing- Electronics Printing. Business Opportunities and Future Directions – Case studies: Automobile, Aerospace, Healthcare.

UNIT II DESIGN FOR ADDITIVE MANUFACTURING (DfAM) 9

Concepts and Objectives - AM Unique Capabilities - Part Consolidation – Topology Optimization- Generative design - Lattice Structures - Multi-Material Parts and Graded Materials - Data Processing: CAD Model Preparation AM File formats: STL-Problems with STL- AMF Design for Part Quality Improvement: Part Orientation - Support Structure - Slicing - Tool Path Generation -- Design rules for Extrusion based AM.

UNIT III VAT POLYMERIZATION AND DIRECTED ENERGY DEPOSITION 9

Photo polymerization: Stereolithography Apparatus (SLA)- Materials -Process – top down and bottom-up approach - Advantages – Limitations- Applications. Digital Light Processing (DLP) - Process - Advantages - Applications. Continuous Liquid Interface Production (CLIP)Technology- Directed Energy Deposition: Laser Engineered Net Shaping (LENS)- Process - Material Delivery - Materials -Benefits –Applications.

UNIT IV POWDER BED FUSION AND MATERIAL EXTRUSION 9

Powder Bed Fusion: Selective Laser Sintering (SLS): Process - Powder Fusion Mechanism - Materials and Application. Selective Laser Melting (SLM), Electron Beam Melting (EBM):

Materials- Process - Advantages and Applications Material Extrusion: Fused Deposition Modeling (FDM)- Process-Materials -Applications and Limitations

UNIT V ADVANCED ADDITIVE MANUFACTURING PROCESSES 9

Binder Jetting: Three-Dimensional Printing - Materials - Process - Benefits- Limitations – Applications Material Jetting: Multijet Modeling- Materials - Process - Benefits – Applications Sheet Lamination: Laminated Object Manufacturing (LOM)- Basic Principle-Mechanism: Gluing or Adhesive Bonding - Thermal Bonding- Materials-Application and Limitation

TOTAL: 45 PERIODS

COURSE OUTCOMES

At the end of this course students shall be able to

1. Analyze and evaluate the development of Additive Manufacturing (AM) technology and its propagation into various business sectors and emerging opportunities.
2. Apply and analyze AM processes to transform a conceptual design into a final product.
3. Analyze and evaluate vat polymerization and direct energy deposition processes based on process characteristics and application suitability.
4. Analyze powder bed fusion and material extrusion processes by comparing their process steps and application domains.
5. Evaluate the advantages, limitations, and applications of binder jetting, material jetting, and sheet lamination processes.

TEXT BOOKS

1. Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani "Additive manufacturing technologies". 3rd edition Springer Cham, Switzerland. (2021). ISBN: 978-3-030-56126-0.
2. Andreas Gebhardt and Jan-Steffen Hötter "Additive Manufacturing: 3D Printing for Prototyping and Manufacturing", Hanser publications, United States, 2015, ISBN: 978-1-56990-582-1.

REFERENCES

1. Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing", Hanser Gardner Publication, Cincinnati., Ohio, 2011, ISBN :9783446425521.
2. Milan Brandt, "Laser Additive Manufacturing: Materials, Design, Technologies,
3. and Applications", Woodhead Publishing., United Kingdom, 2016, ISBN: 9780081004333.
4. Amit Bandyopadhyay and Susmita Bose, "Additive Manufacturing", 1st Edition, CRC Press., United States, 2015, ISBN-13: 978-1482223590.
5. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer.,

United States, 2006, ISBN: 978-1-4614-9842-1.
6. Liou, L.W. and Liou, F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press., United States, 2011, ISBN: 9780849334092.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	1	1	3	3	-	1	2	2	-	2	3	2	1
CO2	3	2	3	1	3	3	2	2	2	2	-	2	3	2	3
CO3	3	-	3	1	3	3	2	-	3	2	-	2	3	2	3
CO4	3	2	2	2	3	3	2	2	2	2	2	2	3	2	3
CO5	3	-	2	-	1	3	-	2	2	2	-	2	3	2	2
Avg.	**3**	**2**	**2**	**1**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**2**	**3**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3023 LEAN MANUFACTURING

L	T	P	C
3	**0**	**0**	**3**

COURSE OBJECTIVES

1. Apply the basic principles of Six Sigma to simple process improvement scenarios.
2. Apply lean manufacturing tools to identify waste and improve operational efficiency.
3. Analyze lean manufacturing methodologies to understand their impact on process performance.
4. Analyze lean concepts and their elements to determine their role in continuous improvement.
5. Analyze lean manufacturing implementation strategies and challenges in organizational contexts.

UNIT I BASICS OF 6 SIGMA 9

Introduction to 6 Sigma, basic tools of six sigma like problem solving approach, standard deviation, normal distribution, various sigma levels with some examples, value for the enterprise, Variation, and sources of variation, Mean and moving the mean, Various quality costs, cost of poor quality.

UNIT II LEAN MANUFACTURING TOOLS 9

Process Capability Indices, Cause and Effect diagram, Control Charts, Introduction to FMEA, APQP, PPAP. 3 foundational 6 Sigma methodologies: DMAIC, DMEDI, and Process Management DMEDI for process creation, DMAIC for process improvement and PDCA for sustaining improvements.

UNIT III DEEPER UNDERSTADING METHODOLOGIES 9

What is a process, Why Process management, Keys to process management, Difference between process management and 6 Sigma, Introduction to Deming cycle, PDCA, DMAIC and continuous improvement, DMEDI for creation process, DMAIC Vs DMEDI with examples, Introduction to Toyota Production System, Six Sigma and Production System integration.

UNIT IV LEAN ELEMENTS 9

Introduction to Lean Concepts like In-Built Quality, Concept of Right Part at the Right Time, Lead Time reduction, Optimum utilization of Capital, Optimum utilization of People. Understanding the Zero-defect concept and Metrics, Focus on Human Resources, Quality, Delivery, Cost. Building Zero defect capabilities, Cultural and Organizational aspects

UNIT V IMPLEMENTATION AND CHALLENGES 9

Implementing Checks and Balances in the process, Robust Information Systems, Dashboard, follow up and robust corrective and preventive mechanism. Concept of Audits, and continuous improvement from gap analysis, risk assessments etc.

TOTAL :45 PERIODS

COURSE OUTCOMES

At the end of this course students shall be able to

1. Apply and analyze Six Sigma principles to basic process improvement situations.
2. Apply lean manufacturing tools to identify waste and improve process efficiency.
3. Analyze and evaluate lean manufacturing methodologies to understand their impact on organizational performance.
4. Analyze lean concepts and their elements to support continuous improvement initiatives.
5. Evaluate lean manufacturing implementation strategies and challenges in real-world industrial context.

TEXT BOOKS

1. Quality Planning and Analysis- JM Juran& FM Gryna. Tata Mc Graw Hill
2. Lean Manufacturing: Principles to Practice by Akhilesh N. Singh, Bibliophile South Asia
3. The Toyota Way: 14 Management Principles
4. Gemba Kaizen: A Commonsense Approach to a Continuous Improvement Strategy, Masaki Imai

REFERENCES

1. Quality Council of India https://qcin.org/, its library. https://qcin.org/nbqp/knowledge_bank/
2. International Society of Six Sigma Professionals: https://isssp.org/about-us/

3. NPTEL / SWAYAM: https://nptel.ac.in/courses/110105123: Six Sigma, Prof. Jitesh J Thakkar, IIT Kharagpur, Certification course. (Self- Learning).
4. Older / Previous editions of AIAG manuals on APQP, FMEA and PPAP. These are great sources of information on Quality Planning and has basics of Project Management and required skills.
5. Quality Management for Organizations Using Lean Six Sigma Techniques- Erick C Jones

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	1	1	-	-	-	1	-	3	1	1	2	1
CO2	1	1	2	1	1	-	-	-	1	-	3	1	1	2	1
CO3	1	1	2	1	1	-	-	-	1	-	3	1	1	2	1
CO4	1	1	2	1	1	-	-	-	1	-	3	1	1	2	1
CO5	1	1	2	1	1	-	-	-	1	-	3	1	1	2	1
Avg.	1	1	2	1	1	-	-	-	1	-	3	1	1	2	1

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3024 ADVANCED MACHINING PROCESSES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. Analyze advanced machining processes by classifying nontraditional machining methods based on mechanical energy principles.
2. Analyze chemical and electrochemical energy-based machining processes to distinguish their mechanisms and applications.
3. Apply principles of thermo-electric energy-based machining processes to explain their operational characteristic.
4. Analyze nano-finishing processes to assess their role in achieving precision and surface quality.
5. Create conceptual process combinations by integrating hybrid non-traditional machining methods to address complex manufacturing requirements.

UNIT I INTRODUCTION 9

Introduction - Need for non-traditional machining processes - Classification of non-traditional machining processes - Applications, advantages and limitations of non-traditional machining processes - Abrasive jet machining, Abrasive water jet machining, Ultrasonic machining their principles, equipment, effect of process parameters, applications, advantages and limitations.

UNIT II CHEMICAL AND ELECTRO CHEMICAL ENERGY BASED PROCESSES 9

Principles, equipments, effect of process parameters, applications, advantages and limitations of Chemical machining, Electro-chemical machining, Electro-chemical honing, Electro-chemical grinding, Electro chemical deburring.

UNIT III THERMO-ELECTRIC ENERGY BASED PROCESSES 9

Principles, equipments, effect of process parameters, applications, advantages and limitations of Electric discharge machining, Wire electric discharge machining, Laser beam machining, Plasma arc machining, Electron beam machining, Ion beam machining.

UNIT IV NANO FINISHING PROCESSES 9

Principles, equipments, effect of process parameters, applications, advantages and limitations of Abrasive flow machining – Chemo mechanical polishing, Magnetic abrasive finishing, Magnetorheological finishing, Magneto rheological abrasive flow finishing.

UNIT V HYBRID NON-TRADITIONAL MACHINING PROCESSES 9

Introduction - Various hybrid non-traditional machining processes, their working principles, equipments, effect of process parameters, applications, advantages and limitations. Selection and comparison of different nontraditional machining processes.

TOTAL :45 PERIODS

COURSE OUTCOMES

At the end of this course students shall be able to

1. Analyze and evaluate non-traditional machining processes with emphasis on mechanical energy–based machining methods.
2. Apply and analyze chemical and electrochemical energy–based machining processes to explain their working principles and applications.
3. Evaluate thermo-electric energy–based machining processes based on process characteristics and performance criteria.
4. Analyze nano-finishing processes to assess their role in achieving precision and surface quality.
5. Analyze and evaluate hybrid non-traditional machining processes and differentiate them from conventional non-traditional machining methods.

TEXT BOOKS

1. Adithan. M., “Unconventional Machining Processes”, Atlantic, New Delhi, India, 2009. ISBN 13:9788126910458

2. Anand Pandey, “Modern Machining Processes”, Ane Books Pvt. Ltd., New Delhi, India, 2019.

REFERENCES

1. Benedict, G.F., “Non-traditional Manufacturing Processes”, Marcel Dekker Inc., New York 1987. ISBN-13: 978-0824773526.
2. Carl Sommer, “Non-Traditional Machining Handbook”, Advance Publishing., United States, 2000, ISBN-13: 978-1575373256.
3. Golam Kibria, Bhattacharyya B. and Paulo Davim J., “Non-traditional Micromachining Processes: Fundamentals and Applications”, Springer International Publishing., Switzerland, 2017, ISBN:978-3-319-52008-7.
4. Jagadeesha T., “Non-Traditional Machining Processes”, I.K. International Publishing House Pvt. Ltd., New Delhi, India, 2017, ISBN-13: 978-9385909122.
5. Kapil Gupta, Neelesh K. Jain and Laubscher R.F., “Hybrid Machining Processes: Perspectives on Machining and Finishing”, 1st edition, Springer International Publishing., Switzerland, 2016, ISBN13: 978-3319259208

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	1	1	1	1	1	1	2	3	2	2
CO2	3	3	2	2	3	1	1	1	1	1	1	2	3	2	2
CO3	3	3	2	3	3	1	1	1	1	1	1	2	3	3	2
CO4	2	2	2	2	3	1	1	1	1	1	1	2	3	3	2
CO5	3	3	2	2	3	1	1	1	1	1	1	2	3	3	2
Avg.	**3**	**3**	**2**	**3**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**3**	**3**	**2**

“1” - low, “2” - medium, “3” - high, “-” - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3025 DIGITAL MANUFACTURING

L	T	P	C
3	**0**	**0**	**3**

COURSE OBJECTIVES

1. Analyze key aspects of digital manufacturing to understand their role in modern production systems.
2. Evaluate the importance of digital manufacturing in Product Lifecycle Management and Supply Chain Management.
3. Apply principles of smart manufacturing to formulate digital work environments.
4. Analyze the role of IoT in supporting and enhancing digital manufacturing systems.

5. Evaluate the significance of digital twins in improving design, monitoring, and decision-making processes.

UNIT I INTRODUCTION 9

Introduction – Need – Overview of Digital Manufacturing and the Past – Aspects of Digital Manufacturing: Product life cycle, Smart factory, and value chain management – Practical Benefits of Digital Manufacturing – The Future of Digital Manufacturing.

UNIT II DIGITAL LIFE CYCLE & SUPPLY CHAIN MANAGEMENT 9

Collaborative Product Development, Mapping Requirements to specifications – Part Numbering, Engineering Vaulting, and Product reuse – Engineering Change Management, Bill of Material and Process Consistency – Digital Mock up and Prototype development – Virtual testing and collateral. Overview of Digital Supply Chain - Scope& Challenges in Digital SC - Effective Digital Transformation - Future Practices in SCM

UNIT III SMART FACTORY 9

Smart Factory – Levels of Smart Factories – Benefits – Technologies used in Smart Factory – Smart Factory in IoT- Key Principles of a Smart Factory – Creating a Smart Factory – Smart Factories and Cybersecurity

UNIT IV INDUSTRY 4.0 9

Introduction – Industry 4.0 –Internet of Things – Industrial Internet of Things – Framework: Connectivity devices and services – Intelligent networks of manufacturing – Cloud computing – Data analytics –Cyber physical systems –Machine to Machine communication – Case Studies.

UNIT V STUDY OF DIGITAL TWIN 9

Basic Concepts – Features and Implementation – Digital Twin: Digital Thread and Digital Shadow- Building Blocks – Types – Characteristics of a Good Digital Twin Platform – Benefits, Impact & Challenges – Future of Digital Twins.

TOTAL :45 PERIODS

COURSE OUTCOMES

At the end of this course students shall be able to

1. Apply digital manufacturing elements to support planning, execution, and monitoring of manufacturing systems.
2. Analyze concepts involved in the digital product development life cycle and supply chain management within a digital environment.
3. Apply and evaluate digital validation procedures to verify and validate practical manufacturing work in smart factories.
4. Apply and analyze IoT concepts to examine their role and impact in digital manufacturing systems.

5. Analyze and evaluate manufacturing processes using digital twin models to optimize performance and decision-making.

TEXT BOOKS

1. Zude Zhou, Shane (Shengquan) Xie and Dejun Chen, Fundamentals of Digital Manufacturing Science, Springer-Verlag London Limited, 2012.
2. Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", A press, 2016.

REFERENCES

1. Lihui Wang and Andrew YehChing Nee, Collaborative Design and Planning for Digital Manufacturing, Springer-Verlag London Limited, 2009.
2. Andrew Yeh Chris Nee, Fei Tao, and Meng Zhang, "Digital Twin Driven Smart Manufacturing", Elsevier Science., United States, 2019.
3. Alp Ustundag and Emre Cevikcan, "Industry 4.0: Managing The Digital Transformation", Springer Series in Advanced Manufacturing., Switzerland, 2017
4. Ronald R. Yager and Jordan Pascual Espada, "New Advances in the Internet of Things", Springer., Switzerland, 2018.
5. Ronald R. Yager and Jordan Pascual Espada, "New Advances in the Internet of Things", Springer., Switzerland, 2018.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	1	1	3	3	-	1	2	2	-	2	3	2	1
CO2	3	2	3	1	3	3	2	2	2	2	-	2	3	2	3
CO3	3	-	3	1	3	3	2	-	3	2	-	2	3	2	3
CO4	3	2	2	2	3	3	2	2	2	2	2	2	3	2	3
CO5	3	-	2	-	1	3	-	2	2	2	-	2	3	2	2
Avg.	**3**	**1**	**3**	**2**	**3**	**3**	**2**	**2**	**3**	**3**	**1**	**3**	**3**	**3**	**3**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3026 **INDUSTRIAL ROBOTICS**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. Analyze the anatomy, classification, and specifications of industrial robots to determine their suitability for manufacturing tasks.
2. Apply robot kinematics and trajectory planning methods to solve basic motion planning problems.

3. Analyze robot dynamics and motion control strategies for effective robotic system performance.
4. Analyze sensors, actuators, robot programming techniques, and simulation tools to develop functional robotic applications.
5. Evaluate industrial robotic applications, safety practices, and emerging technologies to assess their impact on modern automation.

UNIT I INTRODUCTION TO INDUSTRIAL ROBOTS 9

Definition and evolution of industrial robots – Classification: Based on coordinate system, control, and application – Robot anatomy: Manipulator, End-Effector, Drive Systems – Robot specifications: Payload, Reach, Speed, Accuracy, Repeatability – Industrial applications: Material handling, Assembly, Welding, Painting, Packaging

UNIT II ROBOT KINEMATICS AND TRAJECTORY PLANNING 9

Degrees of Freedom (DOF) – Workspace analysis – Forward Kinematics – Inverse Kinematics – Homogeneous Transformation Matrices – Trajectory planning: Point-to-Point, Continuous Path – Motion Interpolation Techniques.

UNIT III ROBOT DYNAMICS AND CONTROL 9

Robot dynamics: Newton-Euler and Lagrange Formulations – Control Systems: Open-loop and Closed-loop Control – Servo Motors and Stepper Motors – Control Strategies: Position, Velocity, Force Control – Robot motion simulation using MATLAB/Simulink.

UNIT IV SENSORS, ACTUATORS AND ROBOT PROGRAMMING 9

Sensors: Proximity, Vision, Force/Torque, Encoders – Actuators: Electric, Hydraulic, Pneumatic – Sensor Integration and Feedback – Robot Programming: Teach Pendant, Offline Programming, RAPID, VAL, Python – Simulation Software: RoboDK, MATLAB – Simple Pick-and-Place Programming Tasks

UNIT V APPLICATIONS AND TRENDS IN INDUSTRIAL ROBOTICS 9

Industrial Applications: Welding, Painting, Assembly, Packaging – Collaborative Robots (Cobots) – Flexible Manufacturing Systems (FMS) – Safety Considerations – Emerging Trends: AI, Machine Learning, IoT in Robotics – Case Studies: Robotic Arm in Assembly Line, Autonomous Mobile Robots, Drone-based Material Handling.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Analyze the evolution, classification, anatomy, specifications, and applications of industrial robots.
2. Apply and analyze kinematic models and trajectory planning techniques to evaluate robotic motion.

3. Analyze and evaluate robot dynamics and control strategies for effective robotic system performance.
4. Apply and analyze sensors, actuators, and robot programming techniques using simulation tools.
5. Evaluate industrial robotic applications and emerging trends including safety, AI, ML, and IoT in robotics

TEXT BOOKS

1. Mikael P. Groover, Industrial Robotics: Technology, Programming, and Applications, McGraw-Hill.
2. Saeed B. Niku, Introduction to Robotics: Analysis, Systems, Applications, Wiley.

REFERENCES

1. Richard D. Klafter, Thomas A. Chmielewski, Michael Negin, Robotics Engineering, Prentice Hall.
2. Roland Siegwart, Illah R. Nourbakhsh, Introduction to Autonomous Mobile Robots, MIT Press
3. Craig, J.J., Introduction to Robotics: Mechanics and Control, Pearson, 4th Edition.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	1	1	1	1	2	1	2	3	2	1
CO2	3	3	3	2	3	1	1	1	1	2	1	2	3	3	2
CO3	3	3	3	2	3	1	1	1	1	2	1	3	3	3	2
CO4	3	2	3	2	3	1	1	1	2	2	1	3	3	3	3
CO5	3	2	3	2	3	2	2	1	2	3	2	3	3	3	3
Avg.	**3**	**2**	**3**	**2**	**2**	**1**	**1**	**1**	**1**	**2**	**1**	**3**	**3**	**3**	**2**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3027 **MEMS**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. Analyze MEMS concepts, structures, and applications to determine their relevance in engineering systems.
2. Analyze MEMS fabrication technologies and micromachining processes for device realization.

3. Analyze the mechanical behavior of microstructures to predict performance under operating conditions.
4. Apply sensing and actuation principles to evaluate MEMS device functionality.
5. Evaluate real-world MEMS applications through case studies to assess design choices and performance outcomes.

UNIT I INTRODUCTION TO MEMS 9

Overview of MEMS, new trends in engineering and science, micro and nano scale systems, intrinsic characteristics of MEMS, elements of MEMS: micro sensors and micro actuators, microelectronics fabrication process, energy domains, materials for MEMS: silicon, polymers, metals; Packaging and integration: glass encapsulation, MEMS process integration strategies, applications of micro and nanoelectromechanical systems.

UNIT II FABRICATION TECHNOLOGIES 9

Surface micromachining: Sacrificial layer processes, micro motors; Bulk micromachining: micro needles, micro nozzles; Etching: dry etching, plasma etching; Wet etching: principle and process architect; High Aspect-Ratio Processes: LIGA process, Deep Reactive Ion Etching (DRIE); Thin film deposition: Chemical Vapor Deposition (CVD), Physical Vapor Deposition (PVD); Evaporation and sputtering.

UNIT III MECHANICAL CONCEPTS 9

Crystal planes and orientation, Internal force analysis, mechanical properties of silicon and related thin films, flexural beam bending analysis under simple loading conditions, torsional deflections, spring constant and resonant frequency.

UNIT IV SENSING AND ACTUATION TECHNIQUES 9

Micro sensors: Electrostatic sensor, principle of parallel plate capacitors and its applications, Thermal sensor: Fundamentals of thermal transfer, thermal bimorph principle, Piezoresistive sensor: Materials, piezoresistivity, Piezoelectric sensor: Materials and Piezoelectric effect,

Micro actuators: Actuation using thermal forces, Actuation using shape memory alloys, Actuation using piezoelectric crystals, Actuation using electrostatic forces (Parallel plate, torsion bar), Actuation using electrostatic forces (Comb drive actuators), Micromechanical motors and pumps.

UNIT V CASE STUDIES OF MEMS 9

MEMS inertial sensors in automobiles: airbag deployment, automobile navigation; MEMS vibratory gyroscope, MEMS accelerometer.

MEMS devices in commercial applications: Inkjet printers, digital micromirror devices (DMD), radio frequency MEMS switches, scanning tunneling microscopes (STM)

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Analyze MEMS fundamentals, key elements, materials, fabrication basics, and major application areas to determine their engineering relevance.
2. Apply and analyze MEMS fabrication processes such as surface and bulk micromachining, etching, thin-film deposition, and high aspect-ratio techniques.
3. Analyze and evaluate mechanical properties of MEMS structures including stress, deflection behavior, spring constants, and resonant frequencies.
4. Apply and analyze sensing principles and actuation mechanisms to assess MEMS device functionality.
5. Evaluate practical MEMS devices such as accelerometers, gyroscopes, RF switches, inkjet heads, and digital micromirrors for real-world applications

TEXT BOOKS

1. Chang Liu, "Foundation of MEMS", 2nd edition, Pearson Education Inc.,2012.
2. Tai Ran Hsu, "MEMS and Microsystems Design and Manufacture", 2nd edition, Tata McGraw Hill, 2008.

REFERENCES

1. Reza Ghodssi, Pinyen, "MEMS Materials and Processes Handbook", Springer Science Business Media, 2011.
2. Rai-Choudhury P., "MEMS and MOEMS Technology and Applications", Prentice Hall of India Learning Private Limited, 2009.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	1	1	1	1	1	1	2	2	2	1
CO2	3	3	2	2	3	1	1	1	1	1	1	2	3	3	2
CO3	3	3	3	3	3	1	1	1	1	1	1	2	3	3	3
CO4	3	3	2	2	3	1	1	1	1	1	1	2	3	3	2
CO5	3	2	2	2	3	2	2	1	1	1	1	2	3	3	2
Avg.	**3**	**3**	**2**	**2**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**3**	**3**	**2**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3028 NANO TECHNOLOGY AND SURFACE ENGINEERING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. Analyze nanoscience and nanotechnology concepts to determine the relevance of nanoscale phenomena in mechanical systems.
2. Apply and analyze physical, chemical, and biological synthesis methods to select appropriate processes for producing nanomaterials.
3. Apply nanomaterial characterization techniques to analyze and interpret experimental data.
4. Analyze and evaluate surface engineering and coating processes to assess their influence on material performance.
5. Evaluate engineering applications of nanotechnology, nanocoatings, smart materials, and emerging manufacturing trends for industrial suitability.

UNIT I INTRODUCTION TO NANOTECHNOLOGY 9

Overview of nanoscience and nanotechnology – Significance and interdisciplinary nature – Atomic structure and nanoscale phenomena – Surface-to-volume ratio and quantum confinement effects – Classification of nanomaterials (0D, 1D, 2D, 3D) – Mechanical, thermal, electrical, and magnetic properties at the nanoscale – Applications in mechanical systems and manufacturing.

UNIT II SYNTHESIS OF NANOMATERIALS 9

Top-down and bottom-up approaches – Physical methods: Mechanical milling, laser ablation, sputtering, evaporation, and lithography – Chemical methods: Sol-gel, chemical vapor deposition (CVD), electrochemical and hydrothermal methods – Biological and green synthesis routes – Parameters influencing nanostructure formation – Safety and environmental aspects in nanomaterial handling.

UNIT III CHARACTERIZATION TECHNIQUES 9

X-ray diffraction (XRD) – Scanning Electron Microscopy (SEM) – Transmission Electron Microscopy (TEM) – Atomic Force Microscopy (AFM) – Scanning Tunneling Microscopy (STM) – Energy Dispersive X-ray (EDX) and XPS analysis – Surface roughness measurement – Nanoindentation and tribological testing methods.

UNIT IV SURFACE ENGINEERING AND COATING TECHNIQUES 9

Surface modification principles – Surface hardening (carburizing, nitriding, boriding, shot peening, laser hardening) – Thermal spraying, PVD, and CVD coatings – Electroplating, anodizing, and conversion coatings – Thin film deposition techniques – Surface texturing for tribological performance – Surface integrity and residual stress effects.

UNIT V APPLICATIONS AND EMERGING TRENDS 9

Nano coatings for wear, corrosion, and thermal resistance – Self-cleaning and super hydrophobic surfaces – Nano composites and smart coatings – Applications in automotive, aerospace, energy, and biomedical systems – Nano-tribology and lubrication – Future trends: 3D Nano manufacturing, additive manufacturing interfaces, and sustainable nanomaterials.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Analyze the principles of nanoscience, nanoscale effects, and classification of nanomaterials to establish their engineering significance.
2. Analyze and evaluate physical, chemical, and biological synthesis methods to determine factors influencing nanomaterial formation.
3. Apply and analyze major nanomaterial characterization techniques (XRD, SEM, TEM, AFM, STM, EDX, XPS) to interpret structural, surface, and tribological properties.
4. Analyze and evaluate surface engineering and coating methods to assess their impact on mechanical behavior and surface integrity.
5. Apply and evaluate nanotechnology concepts in mechanical, automotive, aerospace, biomedical, and energy applications, including emerging nano-manufacturing trends.

TEXT BOOKS

1. Rao, C. N. R., Muller, A., and Cheetham, A. K., The Chemistry of Nanomaterials: Synthesis, Properties and Applications, Wiley-VCH, 2004.
2. Bhushan, B., Springer Handbook of Nanotechnology, 4th Edition, Springer, 2017.
3. Roy, R. K., Surface Engineering for Corrosion and Wear Resistance, ASM International, 2013.

REFERENCES

1. Madou, M. J., Fundamentals of Microfabrication and Nanotechnology, 4th Edition, CRC Press, 2018.
2. Poole, C. P., and Owens, F. J., Introduction to Nanotechnology, Wiley, 2003.
3. Sudarshan, T. S., and Jeandin, M., Surface Modification Technologies, CRC Press, 2010.
4. Lakhtakia, A., Nanostructured Materials: Processing, Properties and Applications, Elsevier, 2007.
5. Gnanamoorthy, R., Nanotechnology and Surface Engineering in Mechanical Systems, McGraw-Hill Education, 2020.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	1	1	1	1	2	1	2	3	2	2
CO2	3	3	3	2	3	1	1	1	1	2	1	2	3	3	2
CO3	3	2	3	2	3	1	1	1	1	2	1	3	3	3	2
CO4	3	2	3	2	3	1	1	1	1	2	1	3	3	3	3
CO5	3	2	3	2	3	2	2	1	2	3	2	3	3	3	3
Avg.	**3**	**2**	**3**	**2**	**3**	**1**	**1**	**1**	**1**	**2**	**1**	**3**	**3**	**3**	**2**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

VERTICAL 3: DESIGN ENGINEERING

24ME3031 COMPUTER AIDED DESIGN AND PROTOTYPING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. Analyse the fundamentals of computer-aided design (CAD) and evaluate its role in modern product development.
2. Examine and differentiate geometric modelling techniques, design automation concepts, and the functionalities of CAD software tools.
3. Analyse computer-aided engineering (CAE) techniques for engineering analysis and design optimization.
4. Evaluate and compare rapid prototyping and additive manufacturing technologies for effective product realization.
5. Analyse and integrate CAD, CAE, and prototyping tools to develop innovative design and manufacturing solutions.

UNIT I FUNDAMENTALS OF CAD AND PRODUCT DESIGN 9

Introduction to CAD in product development - CAD hardware and software components - Fundamentals of product design and design process - Geometric transformations: translation, rotation, scaling, reflection, and their applications in CAD - 2D and 3D geometric modeling concepts.

UNIT II GEOMETRIC AND SOLID MODELING 9

Wireframe modeling, surface modeling, and solid modelling - Parametric and feature-based modelling - Assembly modeling and constraints - CAD software tools and case studies - Data exchange standards (IGES, STEP, STL)

UNIT III COMPUTER-AIDED ENGINEERING 9

Introduction to CAE and design validation - Finite Element Analysis (FEA) fundamentals - Static, thermal, and dynamic analysis of components - Design optimization and simulation tools - Integration of CAD and CAE

UNIT IV PROTOTYPING AND ADDITIVE MANUFACTURING 9

Introduction to prototyping and its importance in product development - Principles of rapid prototyping (RP) and additive manufacturing (AM) - Common AM processes: FDM, SLA, SLS, DMLS, PolyJet, Binder Jetting - Materials used in prototyping and AM - Process chain for CAD-to-prototype conversion.

UNIT V APPLICATIONS AND INTEGRATION 9

Applications of CAD and prototyping in automotive, aerospace, biomedical, and consumer products - Concurrent engineering and collaborative design - Digital twin and Industry 4.0 relevance to CAD and prototyping - Case studies of CAD-CAE-RP integration in product development - Future trends in CAD and rapid prototyping technologies

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Explain the principles of CAD systems, geometric modelling, and product design concepts.
2. Analyse solid modelling and parametric design techniques using CAD tools.
3. Analyse and optimize designs using computer-aided engineering methods.
4. 4.Evaluate and compare suitable prototyping and additive manufacturing technologies for product development.
5. 5.Analyze and integrate CAD, CAE, and prototyping tools to design, simulate, and realize engineering products.

TEXT BOOKS

1. Zeid, I. CAD/CAM: Theory and Practice. McGraw Hill Education, 2009.
2. Groover, M. P. & Zimmers, E. W. CAD/CAM: Computer-Aided Design and Manufacturing. Pearson Education, 2015.
3. Gibson, I., Rosen, D. W., & Stucker, B. Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing. Springer, 2015.

REFERENCES

1. Beumer, S. A., & Kim, Y. H. Engineering Design and Prototyping. Springer, 2018.
2. Chua, C. K., Leong, K. F., & Lim, C. S. Rapid Prototyping: Principles and Applications. World Scientific Publishing, 2010.
3. Farid, A., & Eswaran, C. Computer Aided Engineering Design. Pearson Education, 2008.
4. Kai, C. C., & Leong, K. F. Rapid Prototyping: Principles and Applications in Manufacturing. John Wiley & Sons, 2000.
5. Wohlers, T. Wohlers Report: Additive Manufacturing and 3D Printing. Wohlers Associates, latest edition.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	1	-	-	-	-	3	3	3	2	2
CO2	3	3	3	3	2	1	-	-	-	-	2	2	3	2	2
CO3	3	3	3	3	2	1	-	-	-	-	3	3	3	2	2
CO4	3	3	3	3	2	1	-	-	-	-	3	3	3	2	2

CO5	3	3	3	3	2	1	-	-	-	-	3	3	3	2	2
Avg.	**3**	**3**	**3**	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**3**	**3**	**3**	**2**	**2**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3032 **DESIGN FOR X**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1.To analyse economic process selection and design for manufacturability principles, and examine casting design considerations for cast products.

2.To analyse design consideration principles of forming for extruded, stamped, and forged products.

3.To analyse machining design considerations for turned, drilled, milled, planed, shaped, slotted, and ground products.

4.To analyse welding design consideration principles for welded products.

5. To analyse design consideration principles in additive manufacturing**.**

UNIT I INTRODUCTION 9

General design principles for manufacturability - strength and mechanical factors, mechanisms selection, evaluation method, Process capability - Feature tolerances Geometric Tolerances - Assembly limits -Datum features - Tolerance stacks.

Design to minimize material usage – Design for disassembly – Design for recyclability – Design for manufacture – Design for energy efficiency – Design to regulations and standards.

UNIT II FACTORS INFLUENCING FORM DESIGN 9

Working principle, Material, Manufacture, Design- Possible solutions - Materials choice – Influence of materials on form design - form design of welded members, forgings and castings.

UNIT III COMPONENT DESIGN - MACHINING CONSIDERATION 9

Design features to facilitate machining - drills - milling cutters - keyways - Doweling procedures, counter sunk screws - Reduction of machined area- simplification by separation - simplification by amalgamation - Design for machinability - Design for economy - Design for clampability – Design for accessibility - Design for assembly – Product design for manual assembly - Product design for automatic assembly – Robotic assembly.

UNIT IV COMPONENT DESIGN – CASTING CONSIDERATION 9

Redesign of castings based on Parting line considerations - Minimizing core requirements, machined holes, redesign of cast members to obviate cores. Identification of uneconomical design - Modifying the design - group technology - Computer Applications for DFMA

UNIT V DESIGN FOR ADDITIVE MANUFACTURING 9

Introduction to AM, DFMA concepts and objectives, AM unique capabilities, exploring design freedoms, Design tools for AM, Part Orientation, Removal of Supports, Hollowing out parts, Inclusion of Undercuts and Other Manufacturing Constraining Features, Interlocking Features, Reduction of Part Count in an Assembly, Identification of markings / numbers.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Analyse the design principles for manufacturability.
2. Analyse the factors influencing form design.
3. Analyse the component design features of various machines.
4. Analyse the design consideration principles of welding in welded products.
5. Analyse the design consideration principles of additive manufacturing.

TEXT BOOKS

1. James G. Bralla, “Design for Manufacturability Handbook”, McGraw Hill Professional, 1998.
2. O. Molloy, E.A. Warman, S. Tilley, Design for Manufacturing and Assembly: Concepts, Architectures and Implementation, Springer, 1998.

REFERENCES

1. Corrado Poli, Design for Manufacturing: A Structured Approach, Elsevier, 2001.
2. David M. Anderson, Design for Manufacturability & Concurrent Engineering: How to Design for Low Cost, Design in High Quality, Design for Lean Manufacture, and Design Quickly for Fast Production, CIM Press, 2004.
3. Erik Tempelman, Hugh Shercliff, Bruno Ninaber van Eyben, Manufacturing and Design: Understanding the Principles of How Things Are Made, Elsevier, 2014.
4. Graedel T. Allen By. B, Design for the Environment Angle Wood Cliff, Prentice Hall. Reason Pub., 1996.
5. Boothroyd, G, Heartz and Nike, Product Design for Manufacture, Marcel Dekker, 1994

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	1	2	1	1	1	1	2	1	2	3	2	2
CO2	3	2	2	1	2	1	1	1	1	1	1	2	3	2	2
CO3	3	3	3	2	3	1	1	1	1	2	1	2	3	3	3
CO4	3	2	2	1	2	2	2	1	1	2	1	2	3	2	2
CO5	3	2	2	2	3	1	1	1	1	2	1	2	3	2	3
Avg.	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**3**	**2**	**3**	**3**	**3**	**3**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3033 DESIGN CONCEPTS IN ENGINEERING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. Analyse various design requirements and the processes involved in product development.
2. Analyse design processes required to develop a successful product.
3. Apply scientific approaches to develop appropriate design solutions.
4. Analyse and apply human needs to design suitable solutions.
5. Analyse the principles of material selection, costing, and manufacturing in design.

UNIT I DESIGN TERMINOLOGY 9

Definition-various methods and forms of design-importance of product design-static and dynamic products-various design projects-morphology of design-requirements of a good design-concurrent engineering-computer aided engineering-codes and standards-product and process cycles-bench marking.

UNIT II DESIGN PROCESSES 9

Basic modules in design process-scientific method and design method-Need identification, importance of problem definition-structured problem, real life problem- information gathering -customer requirements- Quality Function Deployment (QFD)- product design specifications-generation of alternative solutions- Analysis and selection-Detail design and drawings-Prototype, modeling, simulation, testing and evaluation

UNIT III CREATIVITY IN DESIGN 9

Creativity and problem solving-vertical and lateral thinking-invention-psychological view, mental blocks-Creativity methods-brainstorming, synectics, force fitting methods, mind map, concept map-Theory of innovative problem solving (TRIZ) - conceptual decomposition creating design concepts.

UNIT IV HUMAN AND SOCIETAL ASPECTS IN PRODUCT DEVELOPMENT 9

Human factors in design, ergonomics, user friendly design-Aesthetics and visual aspects environmental aspects-marketing aspects-team aspects-legal aspects-presentation aspects

UNIT V MATERIAL AND PROCESSES IN DESIGN 9

Material selection for performance characteristics of materials-selection for new design substitution for existing design-economics of materials-selection methods-recycling and material selection-types of manufacturing process, process systems- Design for Manufacturability (DFM) - Design for Assembly (DFA).

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Analyze the various design requirements and processes involved in product development.
2. Analyze the design processes required to develop a successful product.
3. Analyze scientific approaches used to provide effective design solutions.
4. Analyze human needs and apply them to design appropriate solutions.
5. Analyze the principles of material selection, costing, and manufacturing in design.

TEXT BOOKS

1. Dieter. G. N., Linda C. Schmidt, "Engineering Design", McGraw Hill, 2013.
2. Horenstein, M. N., Design Concepts for Engineers, Prentice Hall, 2010.

REFERENCES

1. Dhillon, B. S., Advanced Design Concepts for Engineers, Technomic Publishing Co., 1998.
2. Edward B. Magrab, Satyandra K. Gupta, F. Patrick McCluskey and Peter A. Sandborn, "Integrated Product and Process Design and Development", CRC Press, 2009.
3. James Garratt, "Design and Technology", Cambridge University Press, 1996.
4. Joseph E. Shigley, Charles R.Mische, and Richard G. Budynas, "Mechanical Engineering Design", McGraw Hill Professional, 2003.
5. Sumesh Krishnan and MukulSukla, Concepts in Engineering Design, Notion Press, 2016.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	2	2	1	1	2	1	2	3	2	2
CO2	3	3	3	2	3	2	2	1	2	2	1	2	3	3	3
CO3	3	3	3	3	3	2	2	1	1	2	1	3	3	3	3
CO4	2	2	2	1	2	3	3	2	2	2	2	2	2	2	2
CO5	3	3	3	2	3	2	2	1	1	2	1	2	3	3	3
Avg.	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**3**	**3**	**3**	**3**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3034 **TOOL DESIGN**

L	T	P	C
3	**0**	**0**	**3**

COURSE OBJECTIVE

1. Analyse and apply the principals involved in the design and selection of cutting tools, tool materials, tool geometries, and tool holders to improve machining performance and productivity.

2. Analyse and apply the design and selection of multi-point cutting tools and milling cutters by examining drill and cutter geometry, tool elements, mounting systems, and re-sharpening practices for efficient machining.
3. Apply basic design principles to develop jigs and fixtures that improve machining accuracy and ease of operation.
4. Apply design principles to develop basic press tools and dies for cutting and bending sheet-metal parts.
5. Analyse and apply the design principles of cutting, drawing, bending, and forming dies used in sheet-metal and forging processes.

UNIT I INTRODUCTION 9

Tooling, requirements of a tool designer, general tool design procedure, tool engineering functions and its importance to enhance productivity and quality. Review of cutting tool materials. Tool angles and signature, Carbide inserts grades - ISO designation and applications, tool holders for turning-ISO designation. Solid type tool, brazed tip tool, throwaway indexable insert types, coated carbides and chip breakers- Design of single point cutting tools-Design of shank dimensions using strength and rigidity considerations for rectangular, square and round cross section and selection of tool geometry.

UNIT II DESIGN OF MULTI POINT CUTTING TOOLS 9

Design of Multi Point Cutting Tools- Types of drills, Drill bit design - elements like back taper, web thickness, land width, margin, flute length and cross section and selection of tool geometry. Re-sharpening of drill bit. Tool holders for milling, different tapers used for mounting tool holders in milling, ISO designation. Tool mounting systems - Design of milling cutters - Design of elements like number of teeth and height, circular pitch, body thickness, chamfer width, fillet radius and selection of tool geometry. Profile sharpened and form relieved milling cutters. Re-sharpening of side and face milling cutter and end mill.

UNIT III JIGS AND FIXTURES 9

Jigs and Fixtures - Functions and differences between jigs and fixtures, advantages in mass production, design principles, economics of jigs and fixtures – Location- 3-2-1 Principle of location, different types of locating elements – Clamping - Principles of clamping, types of clamping devices, and power clamping - Drill bushes - Drill jigs - Different types, exercises of designing jigs for simple components - Fixture Design - Turning fixtures, milling fixtures, grinding fixtures, fixturing for CNC machining centers, and modular fixtures. Design exercises on fixtures for turning and milling for simple components.

UNIT IV PRESS TOOLS 9

Press tools - Classification and working of power presses. Concept and calculations of press tonnage and shut height of a press, components of a simple die, press tool operation, die accessories, shearing action in punch & die, clearance, shear on punch and die, Centre of pressure, and strip layout. Simple, progressive, compound, combination and inverted dies.

Design problems on blanking and piercing dies for simple components - Bending dies – Introduction, bend allowance, spring back, edge bending die design.

UNIT V DESIGN OF DIES 9

Power presses types and construction details, die cutting operation, cutting action in die and punch, center of pressure, clearance and its significance, cutting forces, methods of reducing cutting forces, methods of punch support, strippers, stock stops, guide pilots, knockout, design of blanking and piercing dies. Design Concepts and description of the components of progressive dies. Design of progressive dies. Design of compound dies. Design of combination dies. Drawing Dies: Metal flow and factors affecting drawing, blank size calculations, drawing force, single and double acting drawing dies, design and development of drawing dies for different components. Bending and Forming Dies: Spring back, bend allowance; calculation of development length, bending force calculations types of bending dies. Curling dies. Forging process and forging dies. (Introductory Treatment).

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Analyse and apply the selection of cutting tools, tool materials, and tool geometries to improve machining performance, strength, and productivity.
2. Analyse and apply the design and selection of multi-point cutting tools and milling cutters by examining tool geometry, tool elements, and mounting systems for efficient machining.
3. Analyse drill and cutter geometry, tool elements, mounting systems, and re-sharpening methods to apply them in the design and selection of multi-point cutting tools and milling cutters for effective machining.
4. Analyse and apply press operations, force calculations, die components, shearing principles, and layout considerations to design press tools and dies for blanking, piercing, and bending processes.
5. Analyze and apply metal flow behaviour, force calculations, die components, and forming principles in the design of cutting, bending, drawing, progressive, compound, combination, and forging dies.

TEXT BOOKS

1. Donaldson, C., Lecain, G.H., & Goold, V.C. Tool Design, 4th Edition, Tata McGraw-Hill, 2012.
2. K. Nagpal Tool Engineering & Design, New Age International Publishers, 2014.
3. Astro, C., & Russell, J.K. Fundamentals of Tool Design, 7th Edition, SME, 2015.

REFERENCES

1. S. K. Basu, D. K. Pal, & A. K. Gupta, Design of Jigs, Fixtures & Press Tools, 1st Edition, Tata McGraw-Hill, 2010.
2. P. C. Sharma, Production Engineering, S. Chand Publishers, 2014.

3. Jastrzebski, Z. D. Metal Cutting Theory and Practice, Tata McGraw-Hill, 2002.
4. Wilson, F. W. Handbook of Fixture Design, McGraw-Hill, 1997.
5. Benedict, G. Fundamentals of Tool Design, Society of Manufacturing Engineers (SME), 6th Edition, 2010.
6. Paquin, J. R., & Crowley, R. E. Die Design Fundamentals, 2nd Edition, Industrial Press, 2010.
7. ASTME, Tool Engineers Handbook, 4th Edition, SME, 1992.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	1	-	-	-	-	3	3	3	2	2
CO2	3	3	3	3	2	1	-	-	-	-	2	2	3	2	2
CO3	3	3	3	3	2	1	-	-	-	-	3	3	3	2	2
CO4	3	3	3	3	2	1	-	-	-	-	3	3	3	2	2
CO5	3	3	3	3	2	1	-	-	-	-	3	3	3	2	2
Avg.	**3**	**3**	**3**	**3**	**2**	**1**	-	-	-	-	**3**	**3**	**3**	2	2

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3035 TRIBOLOGICAL DESIGN

L	T	P	C
3	**0**	**0**	**3**

COURSE OBJECTIVES

1. Analyse and measure different surface features related to friction in metals and non-metals.
2. Analyse different wear mechanisms and surface modification techniques.
3. Analyse various types of lubricants and lubrication systems used in tribology.
4. Apply appropriate methods to select lubricants and lubrication regimes for different operating conditions.
5. Analyse different types of high-pressure contacts and rolling bearings.

UNIT I SURFACE INTERACTION AND FRICTION 9

Surface Topography – Surface Features-Properties and measurement – Surface interaction – Laws of friction- Adhesive Theory of Sliding Friction – Static friction -Rolling Friction – Friction in extreme conditions –Thermal considerations in sliding contact.

UNIT II WEAR AND SURFACE TREATMENT 9

Types of wear mechanism – Laws of wear –Theoretical wear models- Abrasive wear – Adhesive wear – Fatigue wear – fretting wear – Cavitation wear - Wear of Metals and Nonmetals – Surface treatments – Surface modifications –Laser processing – instrumentation – International standards in friction and wear measurement

UNIT III LUBRICANTS AND LUBRICATION REGIMES 9

Lubricants and their physical properties- Viscosity and other properties of oils –Additives-and selection of Lubricants- Lubricants standards ISO, SAE, AGMA, BIS standards – Lubrication Regimes –Solid Lubrication-Dry and marginally lubricated contacts- Boundary Lubrication Hydrodynamic lubrication-Elasto and plasto hydrodynamic - Magneto hydrodynamic lubrication – Hydro static lubrication – Gas lubrication

UNIT IV THEORY OF HYDRODYNAMIC AND HYDROSTATIC LUBRICATION 9

Reynolds Equation-Assumptions and limitations-One- and two-dimensional Reynolds Equation Reynolds and Sommerfeld boundary conditions- Pressure wave, flow, load capacity and friction calculations in Hydrodynamic bearings-long and short bearings-Pad bearings and Journal Bearings-Squeeze film effects-Thermal Considerations-Hydrostatic lubrication of Pad bearing Pressure, flow, load and friction calculations-Stiffness considerations- Various types of flow restrictors in hydro static bearings.

UNIT V HIGH PRESSURE CONTACTS AND ELASTO HYDRODYNAMIC LUBRICATION 9

Rolling contacts of Elastic solids- contact stresses – Hertzian stress equation- Spherical and cylindrical contacts-Contact Fatigue life- Oil film effects- Elasto Hydrodynamic lubrication Theory Soft and hard EHL Reynolds equation for elasto hydrodynamic lubrication- - Film shape within and outside contact zones-Film thickness and friction calculation- Rolling bearings- Stresses and deflections-Traction drives.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Analyse surface features and their role in the friction behaviour of metals and non-metals.
2. Analyse different types of wear mechanisms and surface modification techniques.
3. Analyse different types of lubricants and lubrication systems in tribology.
4. Apply appropriate methods to select lubricants and lubrication regimes for different operating conditions.
5. Analyse different types of high-pressure contacts and rolling bearings.

TEXT BOOKS

1. B. C. Majumdar, Introduction to Tribology of Bearings, S. Chand Publishing.
2. K. C. Ludema, Friction, Wear, Lubrication: A Textbook in Tribology, CRC Press.
3. G. W. Stachowiak & A. W. Batchelor, Engineering Tribology, 4th Edition, Butterworth-Heinemann, 2014.

REFERENCES

1. Rabinowicz.E, “Friction and Wear of materials”, John Willey & Sons ,UK,1995
2. Cameron, A. “Basic Lubrication Theory”, Ellis Herward Ltd., UK, 1981
3. Halling, J. (Editor) – “Principles of Tribology “, Macmillian – 1984
4. Williams J.A. “Engineering Tribology”, Oxford Univ. Press, 1994
5. S.K.Basu, S.N.Sengupta & B.B.Ahuja ,”Fundamentals of Tribology”, Prentice –Hall of India Pvt Ltd , New Delhi, 2005
6. G.W.Stachowiak& A.W .Batchelor , Engineering Tribology, Butterworth - Heinemann, UK, 200

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	1	-	-	-	-	3	3	3	2	2
CO2	3	3	3	3	2	1	-	-	-	-	2	2	3	2	2
CO3	3	3	3	3	2	1	-	-	-	-	3	3	3	2	2
CO4	3	3	3	3	2	1	-	-	-	-	3	3	3	2	2
CO5	3	3	3	3	2	1	-	-	-	-	3	3	3	2	2
Avg.	**3**	**3**	**3**	**3**	**2**	**1**	-	-	-	-	**3**	**3**	**3**	2	2

“1” - low, “2” - medium, “3” - high, “-” - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3036 MECHANICAL VIBRATIONS

L	T	P	C
3	**0**	**0**	**3**

COURSE OBJECTIVE

1. Analyse the basic concepts of vibrations in single-degree-of-freedom systems with and without damping.
2. Analyse the behaviour of single-degree-of-freedom systems under different forced vibrations and apply damping and isolation methods to control them.
3. Analyse the vibration behaviour of two-degree-of-freedom systems and apply vibration control using absorbers and dampers.
4. Analyse basic methods used to determine vibration characteristics of multi-degree-of-freedom systems.
5. Analyze shaft critical speeds and apply basic vibration measurement tools for practical applications.

UNIT I FREE VIBRATION (SDFS) 9

Single Degree of Freedom Systems: Undamped free vibration: Classical method, Energy method, equivalent systems, Damped free vibration- Viscous damping-underdamping, critical damping, overdamping; Coulomb damping, equivalent damping coefficient.

UNIT II FORCED VIBRATION (SDFS) 9

Forced vibrations of Single Degree Freedom Systems: Steady state forced vibration, sources of excitation, impressed harmonic force, resonance, impressed force due to rotating unbalance, base excitation, transmissibility and isolation, performance of different type of isolators, power absorbed by viscous damping.

UNIT III TWO-DEGREE FREEDOM SYSTEMS 9

Two-degree Freedom Systems: Principal modes of vibration, two masses fixed on tightly stretched string, double pendulum, torsional system with damping, forced vibration with harmonic excitation, undamped dynamic vibration absorber, untuned viscous damper.

UNIT IV MULTI DEGREE FREEDOM SYSTEMS 9

Multi Degree Freedom Systems: Lagrangian method for formulation of equation of motion Rayleigh's method, Dunkerley's method, Stodola method, Rayleigh-Ritz method, Method of matrix iteration.

UNIT V WHIRLING OF SHAFTS & VIBRATION MEASUREMENT 9

Whirling of shafts: Critical speeds of shafts – Critical speed of a light shaft having a single disc – without damping and with damping. Critical speed of a shaft having multiple discs – secondary critical speed. Vibration measurement and Applications: Piezoelectric transducers and linear variable differential transformer transducer; Vibration pickups: Vibrometer, Accelerometer, Vibration exciters- Mechanical exciters, impact hammer and electrodynamic shaker.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Analyze free vibrations of single-degree-of-freedom systems with and without damping.
2. Analyze forced vibration behaviour of single-degree-of-freedom systems and apply vibration reduction methods.
3. Analyze vibration behaviour of two-degree-of-freedom systems and apply absorbers and dampers for vibration control.
4. Apply basic methods to determine vibration characteristics of multi-degree-of-freedom systems.
5. Analyze shaft critical speeds and apply basic vibration measurement instruments in practical situations.

TEXT BOOKS

1. G. K. Groover, Mechanical Vibrations, 8th Edition, Nem Chand & Bros, 2009.

REFERENCES

1. L. Meirovich, Elements of Vibrations Analysis, 1st Edition, Tata McGraw Hill, 1986
2. S. Graham Kelly, Mechanical Vibrations, 1st Edition, Tata McGraw Hill, 1996
3. Singiresu S. Rao, Mechanical Vibrations, 6th Edition, Pearson Education, 2018.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	1	-	-	-	-	3	3	3	2	2
CO2	3	3	3	3	2	1	-	-	-	-	2	2	3	2	2
CO3	3	3	3	3	2	1	-	-	-	-	3	3	3	2	2
CO4	3	3	3	3	2	1	-	-	-	-	3	3	3	2	2
CO5	3	3	3	3	2	1	-	-	-	-	3	3	3	2	2
Avg.	**3**	**3**	**3**	**3**	**2**	**1**	-	-	-	-	**3**	**3**	**3**	2	2

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3037 DESIGN CODES AND STANDARDS

L	T	P	C
3	**0**	**0**	**3**

COURSE OBJECTIVES

1. Analyse the need for codes and standards in industry.
2. Analyze different sources and organizations that publish codes and standards.
3. Analyze government regulations and their applicability.
4. Analyse different codes used in various industries.
5. Analyze codes and standards used in the process industry.

UNIT I INTRODUCTION 9

Introduction to Codes and Standards. What is code? What is Standard?Need for codes and standards. Objective of Codes and Standards. Codes, Standards and Good Engineering Practices.

UNIT II CODES 9

Codes and Standards used in Different Industry. Material, Design, Inspection and Construction Codes. Process Industry Codes. Machinery Design codes. Codes used in Oil and Gas Industry. Welding Codes. Machine Design. Automotive. HVAC. Performance Test Codes. Other Discipline codes

UNIT III STANDARDS 9

Sources of Codes and Standards. Who publishes Codes and Standards? International Societies and Professional Bodies. Process of Standardisation and Code publishing in Professional Bodies and Companies. Interdisciplinary Codes.

UNIT IV REGULATIONS 9

Government and Federal Regulations. Need for them. Indian and International Regulations. Standards organisations. Weather and Climatic codes. IS, ISO, IBR, OISD. Certification Bodies. Authorities and Engineers to certify. PE, Chartered Engineers

UNIT V DESIGN CODES 9

Codes and Standards applicable in Process Industry Equipment Design. Pressure Vessel Design Codes. Heat Exchanger Design Codes. Wind and Seismic Codes. Machinery Codes. Package Equipment Design Codes. Performance Test Codes. ASTM, ASME, API, AWS, ANSI, ISO, ASHRAE.

TOTAL:45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Analyse the need for codes and standards in industry.
2. Analyse the different codes and standards used in various industries.
3. Analyse the sources of different codes and standards, the societies that publish them, and their evolution.
4. Analyse the need for government regulations and certification authorities, and common regulations in India and internationally.
5. Analyse codes and standards used in process equipment design for the oil and gas industry.

TEXT BOOKS:

1. Mechanical Engg. Handbook. ASME. ASTM.API
2. Perrys Chemical Engg Handbook

REFERENCES

1. ASME
2. API
3. ISO, IBR, OISD
4. AWS
5. ISHRAE

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	3	-	-	-	-	-	1	-	-	1	1	2	2
CO2	2	1	3	-	-	-	-	-	1	-	-	1	1	2	2
CO3	2	1	3	-	-	-	-	-	1	-	-	1	1	2	2
CO4	2	1	3	-	-	-	-	-	1	-	-	1	1	2	2
CO5	2	1	3	-	-	-	-	-	1	-	-	1	1	2	2
Avg.	**2**	**1**	**3**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**1**	**1**	**2**	**2**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3038 ERGONOMICS IN DESIGN

L	T	P	C
3	**0**	**0**	**3**

COURSE OBJECTIVES

1. Analyze industrial design principles based on ergonomics.
2. Analyze ergonomics concepts in manufacturing processes.
3. Apply ergonomics principles in the design of controls and displays.
4. Apply environmental factors in ergonomics-based design.
5. Analyse and apply aesthetics in manufacturing and product design

UNIT I INTRODUCTION 9

An approach to industrial design, Elements of design structure for industrial design in engineering application in modern manufacturing systems- Ergonomics and Industrial Design: Introduction to Ergonomics, Communication system, general approach to the man-machine relationship, Human component of work system, Machine component of work system, Local environment-light, Heat, Sound.

UNIT II ERGONOMICS AND PRODUCTION 9

Introduction, Anthropometric data and its applications in ergonomic, working postures, Body Movements, Work Station Design, Chair Design. Visual Effects of Line and Form: The mechanics of seeing, Psychology of seeing, Figure on ground effect, Gestalt's perceptions - Simplicity, Regularity, Proximity, Wholeness. Optical illusions, Influences of line and form.

UNIT III DESIGN PRINCIPLES FOR DISPLAY AND CONTROLS 9

Displays: Design Principles of visual Displays, Classification, Quantitative displays, Qualitative displays, check readings, Situational awareness, Representative displays, Design of pointers, Signal and warning lights, colour coding of displays, Design of multiple displays Controls: Design considerations, Controls with little efforts – Push button, Switches, rotating Knobs. Controls with muscular effort – Hand wheel, Crank, Heavy lever, Pedals. Design of controls in automobiles, Machine Tools

UNIT IV ENVIRONMENTAL FACTORS 9

Colour: Colour and light, Colour and objects, Colour and the eye – after Image, Colour blindness, Colour constancy, Colour terms – Colour circles, Munsel colour notation, reactions to colour and colour combination – colour on engineering equipments, Colour coding, Psychological effects, colour and machine form, colour and style.

UNIT V AESTHETIC CONCEPTS 9

Concept of unity, Concept of order with variety, Concept of purpose, Style and environment, Aesthetic expressions - Symmetry, Balance, Contrast, Continuity, Proportion. Style - The components of style, House style, Style in capital good. Introduction to Ergonomic and plant layout software's, total layout design

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Analyze the need for ergonomics in industrial design.
2. Apply ergonomics principles in the creation of manufacturing systems.
3. Analyse the design of controls and displays.
4. Apply environmental factors in ergonomics-based design.
5. Analyze the importance of aesthetics in manufacturing systems and products.

TEXT BOOKS

1. Ergonomics in Design: Methods and Techniques (Human Factors and Ergonomics) by Marcelo M. Soares, Francisco Rebelo
2. Ergonomics in Product Design by Send points Publishing Co. Ltd.

REFERENCES:

1. Benjamin W.Niebel, Motion and Time Study, Richard, D. Irwin Inc., 7thEdition, 2002
2. Brain Shakel, "Applied Ergonomics Hand Book", Butterworth Scientific London 1988.
3. Bridger, R.C., Introduction to Ergonomics, 2ndEdition, 2003, McGraw Hill Publications.
4. Martin Helander, A Guide to human factors and Ergonomics, Taylor and Francis, 2006
5. Mayall W.H. "Industrial design for Engineers", London Hiffee books Ltd., 1988.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	1	-	-	-	-	3	3	3	2	2
CO2	3	3	3	3	2	1	-	-	-	-	2	2	3	2	2
CO3	3	3	3	3	2	1	-	-	-	-	3	3	3	2	2
CO4	3	3	3	3	2	1	-	-	-	-	3	3	3	2	2
CO5	3	3	3	3	2	1	-	-	-	-	3	3	3	2	2

Avg.	**3**	**3**	**3**	**3**	**2**	**1**	-	-	-	-	**3**	**3**	**3**	2	2

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

VERTICAL 4: MATERIALS ENGINEERING

24ME3041 MATERIALS CHARACTERIZATION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. To understand metallographic techniques and microscope operation for microstructure analysis.
2. To learn the principles of X-ray generation and diffraction for material characterization.
3. To import knowledge on different electron microscopy techniques used for characterisation.
4. To import knowledge on different electron microscopy techniques used for characterisation.
5. To import knowledge on techniques of elemental chemical composition and structure of surface.

UNIT I METALLOGRAPHIC TECHNIQUES 9

Macro examination - applications, metallurgical microscope - construction and principle of working, specimen preparation, light material interaction – Rayleigh Scattering, Abbes theory; magnification, numerical aperture, resolving power, depth of focus, depth of field, different light sources; lenses aberrations and their remedial measures, Principles of microscopy -bright field , dark field, phase contrast, polarization, differential interference contrast, high temperature microscopy; Quantitative metallography – Image analysis for grain size distribution and grain/precipitate shape.

UNIT II X-RAY DIFFRACTION TECHNIQUES 9

Reciprocal lattice, Stereographic projection, X-ray generation, absorption edges, characteristic and continuous spectrum, Bragg's law, Ewald's Sphere, Diffraction methods – Laue, rotating crystal and powder methods. Intensity of diffracted beams –structure factor calculations and other factors. Diffractometer – General features and optics, Counters - Proportional, Scintillating, Geiger counters and semiconductor based.

UNIT III ANALYSIS OF X-RAY DIFFRACTION 9

Line broadening-crystallite size, residual stress; Texture Analysis; Crystal structure determination indexing - Phase identification- ASTM catalogue of Materials identification, quantitative phase estimation, Phase diagram determination, Precise lattice parameter calculation, Determination of residual stress – double angle diffraction.

UNIT IV ELECTRON MICROSCOPY 9

Electron specimen interaction; Construction and operation of Transmission electron microscope (TEM) – specimen preparation techniques- Diffraction mode and image mode, Sources of contrast Selected Area Electron Diffraction, Zone axis, indexing; Construction,

modes of operation and sources of contrast of Scanning electron microscope (SEM), Electron probe micro analysis, Basics of Field ion microscopy (FIB), Scanning Tunnelling Microscope (STM) and Atomic Force Microscope (AFM).

UNIT V SURFACE ANALYSIS 9

Introduction to process model formulation – linear feedback control systems – Optimal control – Adaptive control –Sequence control and PLC& SCADA. Computer process control – Computer process interface – Interface hardware – Computer process monitoring – Direct digital control and Supervisory computer control - Overview of Automatic identification methods – Bar code technology –Automatic data capture technologies- Quality management (SPC) and automated inspection.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Explain metallographic examination techniques, microscope optics, and imaging principles, and apply quantitative metallography for microstructure evaluation.
2. Apply X-ray diffraction principles—including Bragg's law, diffraction methods, and detector systems—to analyse crystal structures and diffraction patterns.
3. Interpret XRD data to determine crystallite size, texture, phase identification, lattice parameters, and residual stresses using appropriate analytical methods.
4. Describe the construction, working principles, and contrast mechanisms of TEM, SEM, FIB, STM, and AFM, and select suitable electron/atomic-scale microscopy techniques for material characterization.
5. Apply concepts of surface analysis, process monitoring, digital control, automated inspection, and data acquisition technologies in industrial material evaluation and quality management.

TEXT BOOKS

1. Angelo, P.C., "Materials Characterisation", 1st Edition Cengage Publication, 2016.
2. Cullity, B. D., Stock, S.R. "Elements of X-ray diffraction", Pearson New International Edition, 3rd Edition, 2014.

REFERENCES

1. Brandon D. G, "Modern Techniques in Metallography", Von Nostrand Inc. NJ, USA, 1986.
2. D. A. Skoog, F. James Leary and T. A. Nieman, "Principles of Instrumental Analysis", 7th edition, Cengage Learning, 2017.
3. Thomas G., "Transmission electron microscopy of metals", John Wiley, 1996.
4. Whan R E (Ed), ASM Handbook, Volume 10, Materials Characterisation ", Nineth Edition, ASM international, USA, 1986.

5. Yang Leng, Materials Characterization: Introduction to Microscopic and Spectroscopic Methods, Hong Kong University of Science and Technology, John Wiley & Sons (Asia) Pte Ltd. 2010.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	2	1	–	–	–	–	2	2	3	3
CO2	3	3	2	3	2	3	2	–	–	–	–	3	2	3	3
CO3	3	3	3	3	2	2	1	–	–	–	–	3	2	3	3
CO4	3	3	2	2	2	3	2	–	–	–	–	2	2	3	3
CO5	3	2	2	2	3	2	1	–	–	–	–	3	2	3	3
Avg.	3	3	3	3	3	3	2	–	–	–	–	3	3	3	3

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3042 MECHANICAL BEHAVIOUR OF MATERIALS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. To give an overview of elastic and plastic behaviour of materials
2. To enlighten the different strengthening mechanisms.
3. To give insight into the types of fracture and mechanics of fracture.
4. To provide acumen towards fatigue behavior of materials.
5. To render exposure to high temperature behavior of materials.

UNIT I ELASTIC AND PLASTIC BEHAVIOUR 9

Elastic behaviour of materials - Hooke's law, plastic behaviour: dislocation theory, Types of dislocations- Burger's vectors and dislocation loops, dislocations in the FCC, HCP and BCC lattice, stress fields and energies of dislocations, forces on and between dislocations, dislocation climb, intersections of dislocations, Jogs, dislocation sources, multiplication of dislocations, dislocation pile- ups, Slip and twinning. Methods of observing dislocations

UNIT II STRENGTHENING MECHANISMS 9

Elementary discussion of cold working, grain boundary strengthening. Solid solution strengthening, Martensitic strengthening, Precipitation strengthening, Particulate Strengthening, Dispersion strengthening, Fiber strengthening, Yield point phenomenon, strain aging and dynamic strain aging

UNIT III FRACTURE AND FRACTURE MECHANICS 9

Types of fracture, Basic mechanisms of ductile and brittle fracture, Griffith's theory of brittle fracture, Orowan's modification. Izod and Charpy Impacts tests, Ductile to Brittle Transition Temperature (DBTT), Factors affecting DBTT, Determination of DBTT. Fracture mechanics-

Introduction, Modes of fracture, Stress intensity factor, Fracture toughness and Determination of KIC.

UNIT IV FATIGUE BEHAVIOUR AND TESTING 9

Fatigue: Stress cycles, S-N curves, Effect of mean stress, Factors affecting Fatigue, Structural changes accompanying fatigue, Cumulative damage- Miner law, HCF / LCF, creep- fatigue interactions, micro-mechanisms of fatigue crack initiation and growth, fatigue testing machines- Pari's Equation, Residual life prediction under Fatigue. Macro, Microstructural features of fatigue fracture

UNIT V CREEP BEHAVIOUR AND TESTING 9

Creep curve, Stages in creep curve and explanation, Structural changes during creep, Creep mechanisms, Metallurgical factors affecting creep, High temperature alloys, Stress rupture testing, Creep testing machines, creep life prediction-Omega (Damage rate) method, Larson-Miller (parametric) method. Deformation Mechanism Maps according to Frost/Ashby, Super-plasticity.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Identify the role of dislocations and the mechanisms of plastic deformation.
2. Explain the strengthening mechanisms of polycrystalline and composite materials.
3. Analyze the nature of fracture and its underlying mechanism.
4. Appraise the micro-mechanics, factors and life predictions of components under fatigue loading.
5. Assess the behavior of materials under high temperature, metallurgical factors and life prediction of high temperature materials.

TEXT BOOKS

1. Dieter, G. E., "Mechanical Metallurgy", McGraw-Hill Co., SI Edition, 1995
2. Thomas H. Courtney, "Mechanical Behaviour of Materials", Waveland Press, 2nd edition, 2005

REFERENCES

1. Bhargava A K & Sharma C P, "Mechanical behavior and Testing of materials" PHI learning, 2011.
2. Norman E Dowling, "Mechanical Behaviour of Materials, Pearson 2013
3. Prashant Kumar, "Elements of Fracture Mechanics", McGraw-Hill, 2009.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	1	1	1	1	1	2	3	2	2
CO2	3	3	2	2	2	1	1	1	1	1	1	2	3	3	2
CO3	3	3	3	2	2	2	1	1	1	1	1	2	3	3	3
CO4	3	3	3	3	2	2	1	1	1	2	2	3	3	3	3
CO5	3	3	3	3	2	2	1	1	1	2	2	3	3	3	3
Avg.	3	3	2	2	2	1	1	1	1	1	1	2	3	2	2

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3043 COMPOSITE MATERIALS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. To impart knowledge about different matrix and reinforcement materials and selection of them for composite making.
2. To impart knowledge on various manufacturing methods for making polymer matrix composites.
3. To impart knowledge on various manufacturing techniques interface design and developing different in-situ reactions for making metal matrix composites.
4. To impart knowledge to fabricate different ceramic matrix composites and carbon-carbon composites
5. To impart knowledge to develop constitutive equations for different laminates.

UNIT I INTRODUCTION TO COMPOSITES 9

Fundamentals of composites - need for composites – enhancement of properties - classification of composites – Matrix-Polymer matrix composites (PMC), Metal matrix composites (MMC), Ceramic matrix composites (CMC) – Reinforcement – particle reinforced composites, Fibre reinforced composites. Applications of various types of composites. Fiber production techniques for glass, carbon and ceramic fibers

UNIT II POLYMER MATRIX COMPOSITES 9

Polymer resins – thermosetting resins, thermoplastic resins – reinforcement fibres – rovings – woven fabrics – non woven random mats – various types of fibres. PMC processes - hand lay up processes – spray up processes – compression moulding – reinforced reaction injection moulding - resin transfer moulding – Pultrusion – Filament winding – Injection moulding. Fibre reinforced plastics (FRP), glass fibre reinforced plastics (GRP). Laminates- Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates - applications of PMC in aerospace, automotive industries

UNIT III METAL MATRIX COMPOSITES 9

Characteristics of MMC, various types of metal matrix composites alloy vs. MMC, advantages of MMC, limitations of MMC, Reinforcements – particles – fibres. Effect of reinforcement - volume fraction – rule of mixtures. Processing of MMC – powder metallurgy process - diffusion bonding – stir casting – squeeze casting, In-situ reactions-Interface-measurement of interface properties- applications of MMC in aerospace, automotive industries

UNIT IV CERAMIC MATRIX COMPOSITES AND SPECIAL COMPOSITES 9

Engineering ceramic materials – properties – advantages – limitations – monolithic ceramics - need for CMC – ceramic matrix - various types of ceramic matrix composites- oxide ceramics – non oxide ceramics – aluminium oxide – silicon nitride – reinforcements – particles- fibres- whiskers. Sintering - Hot pressing – Cold isostatic pressing (CIPing) – Hot isostatic pressing (HIPing). applications of CMC in aerospace, automotive industries- Carbon /carbon composites – advantages of carbon matrix – limitations of carbon matrix carbon fibre – chemical vapour deposition of carbon-on-carbon fibre perform. Sol-gel technique

UNIT V MECHANICS OF COMPOSITES 9

Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix (Q_{ij}), Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates.

TOTAL:45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Design and fabricate composite structures.
2. Identify suitable process for different composite components.
3. Design new composites materials for specific requirement.
4. Test and characterize the composites and qualify for the engineering acceptance.
5. Develop and use the constitutive equation for the composite components design

TEXT BOOKS

1. Chawla K. K., "Composite materials", Springer – Verlag, Second Edition, 1998.
2. Mathews F. L. and Rawlings R. D., "Composite Materials: Engineering and Science", Chapman and Hall, London, England, 1st edition, 1994.

REFERENCES

1. Broutman, L.J. and Krock,R.M., "Modern Composite Materials", Addison-Wesley, 1967
2. Clyne, T. W. and Withers, P. J., "Introduction to Metal Matrix Composites", Cambridge University Press, 1993.
3. Sharma, S.C., "Composite materials", Narosa Publications, 2000.
4. Strong, A.B., "Fundamentals of Composite Manufacturing", SME, 1989.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	3	3	-	-	-	-	-	-	-	3	3	-
CO2	2	1	2	3	3	-	-	-	-	-	-	-	3	3	-
CO3	2	1	2	3	3	-	-	-	-	-	-	-	3	3	-
CO4	2	1	2	3	3	-	-	-	-	-	-	-	3	3	-
CO5	2	1	2	3	3	-	-	-	-	-	-	-	3	3	-
Avg.	2	1	2	3	3	-	-	-	-	-	-	-	3	3	-

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3044 FUNDAMENTALS OF NANOMATERIALS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. Provide foundational knowledge on nanomaterials, their classification, and their unique physical/chemical behavior compared to bulk materials
2. Teach various synthesis and processing techniques used for producing nanomaterials using top-down and bottom-up approaches.
3. Develop understanding of advanced characterization tools to analyse microstructure, morphology, and properties of nanomaterials.
4. Explain the mechanical, thermal, electrical, magnetic, and optical properties of nanostructured materials.
5. Enable students to understand and evaluate engineering applications of nanomaterials in modern technological systems.

UNIT I INTRODUCTION TO NANOMATERIALS 9

Definition and scope – Historical background – Classification of nanomaterials (0D, 1D, 2D, 3D) – Quantum confinement – Distinction between nanomaterials and bulk materials – Structure–property relationships – Overview of nanotechnology in engineering systems.

UNIT II SYNTHESIS AND PROCESSING TECHNIQUES 9

Top-down and bottom-up approaches – Physical, chemical, and mechanical synthesis routes – Mechanical alloying, sol-gel process, chemical vapor deposition, electrodeposition, hydrothermal synthesis – Severe plastic deformation – Electrical wire explosion method – Nanoparticle dispersion and stabilization.

UNIT III CHARACTERIZATION OF NANOMATERIALS 9

Principles and applications of characterization techniques – X-ray diffraction (XRD), scanning electron microscopy (SEM), transmission electron microscopy (TEM), atomic force microscopy (AFM), and scanning tunneling microscopy (STM) – Energy-dispersive X-ray spectroscopy (EDX) – Surface analysis and grain size determination.

UNIT IV PROPERTIES OF NANOMATERIALS 9

Mechanical, thermal, electrical, magnetic, and optical properties of nanomaterials – Effect of grain size and surface area – Interface/interphase phenomena – Diffusivity and thermal stability – Strengthening mechanisms in nanostructured materials.

UNIT V ENGINEERING APPLICATIONS OF NANOMATERIALS 9

Nanomaterials in mechanical engineering: coatings, lubricants, composites, and sensors – Nanostructured materials for energy storage and conversion – Nano fluids and their heat transfer applications – Nano electronics and Nano biomaterials – Future trends and sustainability aspects of nanotechnology.

. **TOTAL: 45 PERIODS**

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Formulate governing equations of fluid flow (continuity, momentum, energy, turbulence) and classify PDEs relevant to CFD.
2. Apply finite difference and finite volume methods for solving 1D, 2D, and 3D diffusion problems with suitable schemes.
3. Analyze discretization methods for convection-diffusion problems and select appropriate schemes (upwind, hybrid, QUICK, etc.).
4. Implement pressure-velocity coupling algorithms (SIMPLE, PISO) to analyze flow fields using finite volume methods.
5. Evaluate turbulence models and apply structured/unstructured mesh generation with refinement techniques in CFD simulations.

TEXT BOOKS

1. Bhusan, Bharat (Ed), “Springer Handbook of Nanotechnology”, 2nd edition, 2007.
2. Carl C. Koch (ed.), “Nanostructured Materials, Processing, Properties and Potential Applications”, NOYES Publications, Norwich, New York, U.S.A.

REFERENCES

1. Poole C.P, and Owens F.J., Introduction to Nanotechnology, John Wiley, 2003.
2. Nalwa H.S., Encyclopedia of Nanoscience and Nanotechnology, American Scientific Publishers, 2004.
3. Zehetbauer M.J. and Zhu Y.T., Bulk Nanostructured Materials, Wiley, 2008.
4. Wang Z.L., Characterization of Nanophase Materials, Wiley, 2000.
5. Gutkin Y., Ovid'ko I.A. and Gutkin M., Plastic Deformation in Nanocrystalline Materials, Springer, 2004.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	1	1	1	1	2	1	2	3	2	2
CO2	3	3	3	2	3	1	1	1	1	2	1	2	3	3	2
CO3	3	2	3	2	3	1	1	1	1	2	1	3	3	3	2
CO4	3	2	3	2	3	1	1	1	1	2	1	3	3	3	3
CO5	3	2	3	2	3	2	2	1	2	3	2	3	3	3	3
Avg.	**3**	**2**	**2**	**2**	**3**	**1**	**1**	**1**	**1**	**2**	**1**	**3**	**3**	**3**	**2**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3046 MATERIALS FOR ELECTRONICS

L	T	P	C
3	**0**	**0**	**3**

COURSE OBJECTIVES

1. To introduce the fundamental concepts of electronic materials relevant to mechanical engineering.
2. To explain the structure, properties, and applications of semiconductor, dielectric, magnetic and optical materials.
3. To impart knowledge on conducting, resistive and superconducting materials
4. To expose students to smart materials, MEMS/NEMS materials and emerging electronic applications in mechanical systems.
5. To connect electronic material selection with performance, reliability and energy efficiency in engineering components.

UNIT I INTRODUCTION TO ELECTRONIC MATERIALS 9

Classification of engineering materials – Metals, ceramics, polymers, composites – Basics of electronic materials – Atomic structure, bonding, and crystal structures of solids – Energy bands, conductors, semiconductors, and insulators – Defects in solids – Doping concepts – Influence of microstructure on electronic properties.

UNIT II SEMICONDUCTOR MATERIALS 9

Intrinsic and extrinsic semiconductors – Carrier concentration, mobility, and conductivity – P-N junction concepts – Silicon, germanium, gallium arsenide, and compound semiconductors – Silicon carbide and wide-bandgap materials – Semiconductor wafer processing – Applications in sensors, power devices, and microelectronics.

UNIT III DIELECTRIC, MAGNETIC AND OPTICAL MATERIALS 9

Dielectric materials – Polarization mechanisms – Ferroelectric and piezoelectric materials – Magnetic materials (soft and hard) – Magnetostriction – Optical materials (photoconductors, phosphors, LEDs, lasers) – Electro-optic and magneto-optic materials – Applications in actuators, motors, and optical devices

UNIT IV CONDUCTING, RESISTIVE & SUPER CONDUCTING MATERIALS 9

Conducting materials: metals, alloys, conductive polymers – Resistive materials for heating elements and sensors – Thin-film and thick-film resistor materials – Superconducting materials: types, critical parameters – High-temperature superconductors – Applications in magnetic levitation, energy devices, and precision actuators.

UNIT V ADVANCED MATERIALS FOR ELECTRONICS & MECHANICAL SYSTEMS 9

MEMS & NEMS materials – Smart materials: shape memory alloys, electroactive polymers, MR/ER fluids – Nanomaterials for electronics (CNTs, graphene, quantum dots) – Flexible and printable electronics – Materials for batteries, fuel cells, energy storage – Electronic packaging materials (substrates, encapsulants, TIMs).

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Identify and describe the fundamental properties of electronic materials.
2. Explain semiconductor behavior and its relevance to engineering devices.
3. Analyze dielectric, magnetic, and optical materials for engineering applications.
4. Compare conducting, resistive, and superconducting materials and their uses.
5. Apply knowledge of advanced electronic materials for sensors, actuators, MEMS, and energy systems.

TEXT BOOKS

1. Kasap, S. O., Principles of Electronic Materials and Devices, McGraw-Hill, Latest Edition.
2. Rajendran, V., Materials Science, Tata McGraw-Hill, Latest Edition.
3. Callister, W. D., Materials Science and Engineering, Wiley, Latest Edition.

REFERENCES

1. Goldsmith, A., Materials for Electronic Devices, Springer.
2. Streetman, B. G. & Banerjee, S., Solid State Electronic Devices, Pearson.
3. Raghavan, V., Materials Science and Engineering, PHI.
4. Bansal, R. K., Engineering Materials, Laxmi Publications.
5. Kittel, C., Introduction to Solid State Physics, Wiley.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	1	1	1	1	2	1	2	3	2	2
CO2	3	3	3	2	3	1	1	1	1	2	1	2	3	3	2
CO3	3	2	3	2	3	1	1	1	1	2	1	3	3	3	2
CO4	3	2	3	2	3	1	1	1	1	2	1	3	3	3	3
CO5	3	2	3	2	3	2	2	1	2	3	2	3	3	3	3
Avg.	**3**	**2**	**3**	**2**	**3**	**1**	**1**	**1**	**1**	**2**	**1**	**3**	**3**	**3**	**2**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3047 ADVANCED RARE EARTH MATERIALS

L	T	P	C
3	**0**	**0**	**3**

COURSE OBJECTIVES

1. To introduce the fundamental concepts of electronic materials relevant to mechanical engineering.
2. To explain the structure, properties, and applications of semiconductor, dielectric, magnetic and optical materials.
3. To impart knowledge on conducting, resistive and superconducting materials
4. To expose students to smart materials, MEMS/NEMS materials and emerging electronic applications in mechanical systems.
5. To connect electronic material selection with performance, reliability and energy efficiency in engineering components.

UNIT I INTRODUCTION TO RARE EARTH ELEMENTS AND MATERIALS 9

Overview of rare earth elements (REEs): classification, occurrence, extraction – Physical, chemical, and electronic properties – Distinction between REE-based materials and conventional alloys – Relevance to mechanical and interdisciplinary engineering – Influence of structure on mechanical, magnetic, thermal, and electrical properties – Industrial and energy applications of REEs

UNIT II PROCESSING AND FABRICATION OF REE MATERIALS 9

Extraction and purification – Alloying techniques: vacuum arc melting, mechanical alloying, powder metallurgy – Casting, sintering, and rapid solidification – Thin film deposition and coatings (sputtering, CVD) – Nanostructured REE materials – Scale-up challenges for industrial production.

UNIT III STRUCTURE, PROPERTIES, AND TYPES OF REE MATERIALS 9

REE-based alloys and intermetallics: RCo_5, $R_2Fe_{14}B$, superalloys – Nanostructured REE materials and composites – Mechanical, magnetic, thermal, and electronic properties – Microstructure–property relationships – Surface treatment and functionalization techniques.

UNIT IV CHARACTERIZATION AND ANALYTICAL TECHNIQUES 9

Principles, working, and applications: XRD, SEM, TEM – VSM and SQUID magnetometry – Mechanical property evaluation: nanoindentation, hardness, tensile testing – Thermal analysis – Surface and chemical characterization – Safety and environmental considerations in REE handling.

UNIT V ENGINEERING APPLICATIONS AND EMERGING TRENDS 9

Applications in mechanical engineering: permanent magnets in motors and generators, REE-based superalloys in turbines – Hydrogen storage, batteries, and energy devices – Automotive, robotics, and aerospace applications – Additive manufacturing using REEs – Sustainability, recycling, and future trends.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Identify and describe the fundamental properties of electronic materials.
2. Explain semiconductor behavior and its relevance to engineering devices.
3. Analyze dielectric, magnetic, and optical materials for engineering applications.
4. Compare conducting, resistive, and superconducting materials and their uses.
5. Apply knowledge of advanced electronic materials for sensors, actuators, MEMS, and energy systems.

TEXT BOOKS

1. B. G. Kim, Rare Earth Materials and Their Applications, Springer, 2020.
2. M. S. Kharbanda, Materials Science of Rare Earths, Wiley, 2019.

REFERENCES

1. J. Jensen and A. Mackintosh, Rare Earth Magnetism, Oxford University Press, 2021.
2. S. M. Kauzlarich, Chemistry, Structure, and Properties of Rare Earth Materials, CRC Press, 2018.

3. B. S. Murty et al., Advanced Materials for Energy and Magnetic Applications, Springer, 2022.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	1	1	1	1	2	1	2	3	2	2
CO2	3	3	3	2	3	1	1	1	1	2	1	2	3	3	2
CO3	3	2	3	2	3	1	1	1	1	2	1	3	3	3	2
CO4	3	2	3	2	3	1	1	1	1	2	1	3	3	3	3
CO5	3	2	3	2	3	2	2	1	2	3	2	3	3	3	3
Avg.	**3**	**2**	**3**	**2**	**3**	**1**	**1**	**1**	**1**	**2**	**1**	**3**	**3**	**3**	**2**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3048 CORROSION SCIENCE AND ENGINEERING

L	T	P	C
3	**0**	**0**	**3**

COURSE OBJECTIVES

1. Provide fundamental knowledge on corrosion principles and mechanisms.
2. Explain electrochemical concepts and corrosion thermodynamics.
3. Analyze corrosion kinetics, polarization behaviour and corrosion rate measurements.
4. Discuss methods of corrosion prevention and design of protection systems.
5. Describe the biological and metallurgical influences on corrosion and failure mechanisms.

UNIT I FUNDAMENTALS OF CORROSION 9

Corrosion: definition and basic concepts – Types of corrosion: atmospheric, galvanic, pitting, crevice, intergranular – Stress corrosion cracking, season cracking – Thermodynamics of corrosion – Kinetics of oxidation and corrosion: basic principles.

UNIT II ELECTROCHEMISTRY AND CORROSION DIAGRAMS 9

Basic electrochemistry – Electrochemical cells: galvanic and electrolytic cells – EMF and galvanic series – Potential measurements – Galvanic corrosion and bimetallic contact – Eh–pH diagrams: fundamentals, construction – Corrosion diagrams of copper, aluminium, and general systems.

UNIT III ELECTRODE KINETICS AND POLARIZATION 9

Electrode kinetics – Electrode–solution interface – Types of polarization – Exchange current density – Activation and diffusion-controlled kinetics – Mixed potential theory – Bimetallic couples – Corrosion rate measurement – Polarization techniques and basic concepts.

UNIT IV CORROSION PREVENTION AND CONTROL 9

Corrosion prevention strategies – Organic and metallic coatings – Corrosion inhibitors – Surface engineering – Cathodic protection: principles, types, factors, monitoring, design – Stray current corrosion – Passivity phenomena – Anodic protection – Corrosion-resistant alloys.

UNIT V BIOLOGICAL AND METALLURGICAL ASPECTS 9

Microbiologically Influenced Corrosion (MIC) – Biofilms – Aerobic and anaerobic corrosion – Depolarization theory – Biofouling of titanium and MIC prevention – MIC failure analysis – Corrosion of medical implants and body environment – Biocorrosion of concrete – Metallurgical factors affecting corrosion – Testing procedures.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Explain the fundamental principles and mechanisms of corrosion.
2. Apply electrochemical concepts and Eh–pH diagrams to predict corrosion behaviour.
3. Analyse electrode kinetics and polarization for corrosion rate determination.
4. Select suitable corrosion prevention and protection methods for engineering applications.
5. Assess biological, metallurgical and environmental factors influencing corrosion and degradation.

TEXTBOOKS

1. Denny A. Jones, Principles and Prevention of Corrosion, 2nd Edition, Prentice Hall, 1996.
2. M. G. Fontana, Corrosion Engineering, 3rd Edition, McGraw-Hill, 1987.
3. H. H. Uhlig and R. W. Revie, Corrosion and Corrosion Control, Wiley, 1985.

REFERENCES

1. L. L. Shreir, Corrosion, Vol. I & II, Butterworths, 1976.
2. M. Pourbaix, Atlas of Electrochemical Equilibria in Aqueous Solutions, NACE, 1974.
3. J. D. A. Miller, Microbial Aspects of Metallurgy, 1971.
4. C. A. C. Sequeira, Microbial Corrosion, Maney Publications, 2000.
5. B. J. Little, Microbiologically Influenced Corrosion, Wiley, 2007.
6. H. Videla et al., Manual of Biocorrosion, CRC Press, 1996.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	2	1	1	1	1	1	2	2	2	1
CO2	3	3	2	2	2	2	1	1	1	1	1	2	3	3	2

CO3	3	3	2	3	2	1	1	1	1	1	1	2	3	3	2
CO4	3	2	3	2	2	3	2	1	1	2	1	2	3	2	2
CO5	3	3	2	3	2	3	2	1	1	1	1	2	3	3	2
Avg.	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**1**	**1**	**1**	**1**	**2**	**3**	**3**	**3**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

VERTICAL 5: SUSTAINABLE ENERGY ENGINEERING

24ME3051 RENEWABLE ENERGY TECHNOLOGIES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. To know the present status of Indian and global energy scenario.
2. To learn the various solar energy technologies and its applications.
3. To educate the various wind energy technologies.
4. To explore the various bio-energy technologies.
5. To study the ocean and geothermal technologies.

UNIT I ENERGY SCENARIO 9

Indian energy scenario in various sectors–domestic, industrial, commercial, agriculture, transportation and others – Present conventional energy status – Present renewable energy status-Potential of various renewable energy sources-Global energy status-Per capita energy consumption –Future energy plans

UNIT II SOLAR ENERGY 9

Solar radiation – Measurements of solar radiation and sunshine – Solar spectrum – Solar thermal collectors – Flat plate and concentrating collectors – Solar thermal applications – Solar thermal energy storage – Fundamentals of solar photo voltaic conversion – Solar cells – Solar PV Systems –Solar PV applications.

UNIT III WIND ENERGY 9

Wind data and energy estimation – Betz limit – Site selection for wind farms – characteristics – Wind resource assessment – Horizontal axis wind turbine – components – Vertical axis wind turbine – Wind turbine generators and its performance – Hybrid systems–Environmental issues – Applications.

UNIT IV BIO-ENERGY 9

Bio resources – Biomass direct combustion – thermochemical conversion – biochemical conversion-mechanical conversion – Biomass gasifier – Types of biomass gasifiers – Cogeneration – Carbonisation – Pyrolysis – Biogas plants – Digesters –Biodiesel production – Ethanol production –Applications.

UNIT V OCEAN AND GEOTHERMAL ENERGY 9

Small hydro –Tidal energy–Wave energy–Open and closed OTEC Cycles–Limitations – Geothermal energy–Geothermal energy sources – Types of geothermal power plants – Applications Environmental impact.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Illustrate the Indian and global energy scenario
2. Compare various solar energy technologies and identify its applications.
3. Infer wind data and compare various wind energy systems.
4. Examine various bio-energy technologies and identify their application.
5. Interpret ocean and geothermal energy conversion technologies.

TEXT BOOKS

1. Rai.G.D, Non-conventional sources of energy Khanna publishers 2011
2. Khan.B.H, Non-Conventional Energy Resources Second edition The McGraw Hills, 2009

REFERENCES

1. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press,U.K., 2012.
2. David M. Buchla., "Renewable Energy Systems", pearson education publication, Hard cover/Paperback-2017.
3. Sukhatme.S.P., "Solar Energy: Principles of Thermal Collection and Storage", Tata McGraw Hill Publishing Company Ltd., New Delhi,2009.
4. TiwariG.N., "Solar Energy–Fundamentals Design, Modelling and applications", Alpha Science Intl Ltd, 2015.
5. Mehmet Kanoglu "Fundamentals and Applications of Renewable Energy", Indian edition McGraw Hill Publication, Hard cover/Paperback-2020.
6. Twidell,J.W & WeirA, "Renewable Energy Resources", EFN Spon Ltd., UK, 2015

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	–	–	–	2	–	–	2	–	2	2	2	1
CO2	3	2	2	1	1	–	1	–	–	2	–	2	3	2	2
CO3	3	3	3	1	1	–	2	1	–	2	–	2	3	3	2
CO4	3	3	2	2	1	1	3	2	–	2	–	3	3	3	2
CO5	2	2	2	1	1	–	2	2	–	2	–	2	2	2	2
Avg.	**3**	**3**	**2**	**1**	**1**	**1**	**2**	**1**	–	**2**	–	**2**	**3**	**2**	**2**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3052 HYDROGEN AND FUEL CELL TECHNOLOGIES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. To provide fundamental knowledge of hydrogen, its physical and chemical properties, and its potential as a clean energy carrier.
2. To impart an understanding of hydrogen production methods and their comparative advantages.
3. To develop knowledge of hydrogen storage systems, safety measures, and applications.
4. To study the principles, thermodynamics, kinetics, and types of fuel cells.
5. To evaluate the applications, economics, and future scope of hydrogen and fuel cell technologies.

UNIT I HYDROGEN – BASICS AND PRODUCTION TECHNIQUES 9

Hydrogen – physical and chemical properties, salient characteristics. Production of hydrogen – steam reforming – water electrolysis – gasification and woody biomass conversion – biological hydrogen production – photo dissociation – direct thermal or catalytic splitting of water.

UNIT II HYDROGEN STORAGE AND APPLICATIONS 9

Hydrogen storage options – compressed gas – liquid hydrogen – Hydride – chemical Storage – comparisons. Safety and management of hydrogen. Applications of Hydrogen.

UNIT III FUEL CELLS 9

History – principle - working - thermodynamics and kinetics of fuel cell process – performance evaluation of fuel cell – comparison with battery, cells.

UNIT IV FUEL CELL – TYPES 9

Types of fuel cells – AFC, PAFC, SOFC, MCFC, DMFC, PEMFC – relative merits and demerits.

UNIT V APPLICATION OF FUEL CELL AND ECONOMICS 9

Fuel cell usage for domestic power systems, large scale power generation, Automobile, Space. Economic and environmental analysis on usage of Hydrogen and Fuel cell. Future trends in fuel cells.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Explain the characteristics and significance of hydrogen in sustainable energy systems.
2. Describe and compare various hydrogen production techniques.
3. Apply suitable methods for hydrogen storage and outline safety practices in handling hydrogen.
4. Explain the working principles and classification of fuel cells for different applications.
5. Understand the economic and environmental impacts of hydrogen and fuel cell technologies.

TEXT BOOKS

1. Hydrogen Fuel: Production, Transport, and Storage, Gupta, R. B., CRC press, 2008
2. Hydrogen Generation, Storage and Utilization, Zhang, J. Z., Li, J., Li, Y., Zhao, Y., John Wiley & Sons, 2014.
3. Advances in Hydrogen Production, Storage and Distribution, Iulianelli, A., Basile, A., Elsevier, 2014.
4. Principles of Fuel Cells, by Xianguo Li, Taylor & Francis, 2006
5. Fuel Cells, Principles and Applications, Viswanathan, B. and Scibioh, Aulice M, Universities Press, 2006.
6. Hydrogen and Fuel Cells: Emerging Technologies and Applications, Bent Sørensen, Academic press, 2012.

REFERENCES

1. Barclay F.J., Fuel Cells, Engines and Hydrogen, Wiley, 2009.
2. Bent Sorensen (Sørensen), Hydrogen and Fuel Cells: Emerging Technologies and Applications, Elsevier, UK 2005.
3. Hart A.B. and G.J.Womack, Fuel Cells: Theory and Application, Prentice Hall, New York Ltd., London 1989.
4. Jeremy Rifkin, The Hydrogen Economy, Penguin Group, USA 2002.
5. Kordesch K. and G.Simader, Fuel Cell and Their Applications, Wiley-Vch, Germany 1996.
6. Rebecca L. and Busby, Hydrogen and Fuel Cells: A Comprehensive Guide, Penn Well Corporation, Oklahoma, 2005.
7. Viswanathan B. and Aulice Scibioh.M, Fuel Cells – Principles and Applications, Universities Press, 2006.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	–	–	–	2	–	–	1	–	1	2	2	1
CO2	3	3	2	–	–	–	2	–	–	2	–	2	3	3	1
CO3	2	3	2	1	1	3	3	2	–	2	–	2	2	3	2
CO4	3	3	2	2	1	–	–	–	–	2	–	2	3	2	2
CO5	2	2	3	1	2	2	3	3	1	3	2	3	2	3	3
Avg.	**3**	**3**	**2**	**1**	**1**	**1**	**2**	**1**	**1**	**2**	**1**	**2**	**2**	**3**	**2**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3053 BIOENERGY CONVERSION TECHNOLOGIES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. To elucidate on biomass, types, availability, and characteristics
2. To study the bio-methanation process.
3. To impart knowledge on combustion of biofuels
4. To describe on the significance of equivalence ratio on thermochemical conversion of biomass
5. To provide insight to the possibilities of producing liquid fuels from biomass

UNIT I INTRODUCTION 9

Biomass: types – advantages and drawbacks – typical characteristics – proximate & ultimate analysis – comparison with coal - Indian scenario - carbon neutrality – biomass assessment studies – typical conversion mechanisms - densification technologies

UNIT II BIOMETHANATION 9

Biomethenation process – influencing parameters – typical feed stocks – Biogas plants: types and design, Biogas appliances – burner, luminaries and power generation systems – Industrial effluent-based biogas plants.

UNIT III COMBUSTION 9

Perfect, complete and incomplete combustion – stoichiometric air requirement for biofuels - equivalence ratio – fixed Bed and fluid Bed combustion

UNIT IV GASIFICATION, PYROLYSIS AND CARBONISATION 9

Chemistry of gasification - types – comparison – typical application – performance evaluation – economics. Pyrolysis - Classification - process governing parameters – Typical yield rates. Carbonization – merits of carbonized fuels – techniques adopted for carbonisation

UNIT V LIQUIFIED BIOFUELS 9

Straight Vegetable Oil (SVO) as fuel - Biodiesel production from oil seeds, waste oils and algae – Process and chemistry - Biodiesel Vs. Diesel – comparison on emission and performance fronts. Production of alcoholic fuels (methanol and ethanol) from biomass – engine modifications

TOTAL:45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Estimate the surplus biomass availability of any given area.
2. Design a biogas plant for a variety of biofuels.

3. Determine and compare the cost of steam generation from biofuels with that of coal and petroleum fuels.
4. Analyse the influence of process governing parameters in thermochemical conversion of biomass.
5. Synthesize liquid biofuels for power generation from biomass.

TEXT BOOKS

1. Biomass for Bioenergy and Biomaterials, by Nidhi Adlakha, Rakesh Bhatnagar, Syed Shams Yazdani, CRC Press; 1st edition (22 October 2021), ISBN-10: 0367745550
2. Bioenergy and Biochemical Processing Technologies, by Augustine O. Ayeni, Samuel Eshorame Sanni, Solomon U. Oranusi, Springer (30 June 2022).

REFERENCES

1. David Boyles, Bio Energy Technology Thermodynamics and costs, Ellis Hoknood Chichester,1984.
2. Iyer PVR et al, Thermochemical Characterization of Biomass, M N E S
3. Khandelwal KC, Mahdi SS, Biogas Technology – A Practical Handbook, Tata McGraw Hill, 1986
4. Mahaeswari, R.C. Bio Energy for Rural Energisation, Concepts Publication,1997
5. Tom B Reed, Biomass Gasification – Principles and Technology, Noyce Data Corporation, 1981

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	–	–	–	2	–	–	2	–	2	3	2	1
CO2	3	3	2	–	1	–	2	–	–	2	–	2	3	3	2
CO3	3	3	3	1	1	–	2	1	–	2	–	2	3	3	2
CO4	3	3	3	2	1	–	3	2	–	3	–	3	3	3	3
CO5	2	2	2	1	2	–	2	2	–	2	–	2	2	2	2
Avg.	**3**	**3**	**2**	**1**	**1**	–	**2**	**1**	–	**2**	–	**2**	**3**	**3**	**2**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3054 ENERGY STORAGE TECHNOLOGIES

L	T	P	C
3	**0**	**0**	**3**

COURSE OBJECTIVES

1. To study the various types of energy storage devices and technologies and them comparison.
2. To learn the techniques of various energy storage devices and their performances.
3. To learn the basics of batteries and hybrid systems for EVs and other mobile applications.

4. To learn about the renewable energy storage systems and management systems.
5. To have an insight into other energy storage devices, hydrogen, and fuel cells.

UNIT I INTRODUCTION TO ENERGY STORAGE 9

Need for Energy Storage – Types of Energy Storage – Various forms of Energy Storage – Mechanical– Thermal - Chemical– Electrochemical – Electrical - Other alternative energy storage technologies – Efficiency and Comparison.

UNIT II ENERGY STORAGE SYSTEMS 9

Pumped Air Energy Storage – Compressed Air Energy Storage – Flywheel – Sensible and Latent Heat Storage – Storage Materials – Performance Evaluation - Thermochemical systems – Batteries – Types- Charging and Discharging – Battery testing and performance.

UNIT III MOBILE AND HYBRID ENERGY STORAGE SYSTEMS 9

Batteries for electric vehicles - Battery specifications for cars, heart pacemakers, computer standby supplies – V2G and G2V technologies – HESS.

UNIT IV RENEWABLE ENERGY STORAGE AND ENERGY MANAGEMENT 9

Storage of Renewable Energy Systems –Solar Energy – Wind Energy – Energy Storage in Micro grid–Smart Grid – Energy Conversion Efficiency - Battery Management Systems – EVBMS – Energy Audit and Management

UNIT V OTHER ENERGY DEVICES 9

Superconducting Magnetic Energy Storage (SMES), Supercapacitors – MHD Power generation – Hydrogen Storage - Fuel Cells – Basic principle and classifications – PEMFC, AMFC, DMFC, SOFC, MCFC and Biofuel Cells – Biogas Storage.

TOTAL:45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Discuss the need and identify the suitable energy storage devices for applications.
2. Explain the working of various energy storage devices and their importance.
3. Explain the basic characteristics of batteries for mobile and hybrid systems.
4. Discuss the storage of renewable energies and management systems.
5. Explain the need for other energy devices and their scope for applications.

TEXT BOOKS

1. Rober Huggins, “Energy Storage: Fundamentals, Materials and Applications”, 2 nd Edition, Springer, 2015.
2. Dell, Ronald M Rand, David A J, “Understanding Batteries”, Royal Society of Chemistry, 2001

REFERENCES

1. Francisco Díaz-González, Andreas Sumper, Oriol Gomis-Bellmunt," Energy Storage in Power Systems" Wiley Publication, 2016.
2. Ibrahim Dincer and Mark A Rosen, "Thermal Energy Storage Systems and Applications", John Wiley & amp; Sons, 2002.
3. Lindon David, "Handbook of Batteries", McGraw Hill, 2002.
4. Aulice Scibioh M. and Viswanathan B, "Fuel Cells – principles and applications', University Press (India), 2006
5. Ru-Shiliu, Leizhang, Sueliang Sun, "Electrochemical Technologies for Energy Storage and Conversion", Wiley Publications, 2012.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	–	–	–	1	–	–	1	–	1	2	2	1
CO2	3	3	2	1	1	–	2	–	–	2	–	2	3	3	2
CO3	3	3	2	1	–	–	2	1	–	2	–	1	3	2	2
CO4	3	3	3	2	1	–	3	2	–	2	–	3	3	3	3
CO5	3	2	2	1	1	–	2	2	–	2	–	2	3	2	2
Avg.	**3**	**3**	**2**	**1**	**1**	–	**2**	**1**	–	**2**	–	**2**	**3**	**2**	**2**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3055 ENERGY EFFICIENT BUILDINGS

L	T	P	C
3	**0**	**0**	**3**

COURSE OBJECTIVES

1. To learn the climate and buildings, building efficiency rating and standards
2. Developing energy efficiency in building envelopes through alternate methods
3. To study the thermal comfort, passive heating and cooling techniques
4. To apply various energy saving concepts in buildings.
5. To incorporate Renewable energy systems in buildings

UNIT I INTRODUCTION 9

Climate and Building, Historical perspective, Aspects of Net Zero building design – Sustainable Site, Water, Energy, Materials and IGBC, LEED, GRIHA, IEQ and ECBC Standards

UNIT II LANDSCAPE AND BUILDING ENVELOPES 9

Energy efficient landscape design – Micro climates – various methods – Shading, water bodies – Building envelope: Building materials, Envelope heat loss and heat gain and its evaluation, paints, insulation, Design methods and tools

UNIT III THERMAL COMFORT, PASSIVE HEATING AND COOLING 9

Thermal comfort, Psychrometry, Comfort indices – ASHRAE / ISHRAE Standards on thermal Comfort – Passive heating and cooling systems - HVAC Systems for build environment – Heat Pumps, Evaporative Cooling and Radiant Cooling.

UNIT IV ENERGY CONSERVATION IN BUILDING UTILITIES 9

Energy conservation in Hot water generator – Boiler, Heat Pumps, DG Sets, Motors, Pumps, Illumination Systems, Electrical distribution systems, Cooling Towers, Refrigeration and Air Conditioning Systems, Water and Waste Management systems

UNIT V RENEWABLE ENERGY IN BUILDINGS 9

Introduction of Renewable sources in buildings, Stand-alone PV systems, BIPV, Solar water heating, Solar Air Conditioning in Buildings, Small wind turbines, Poly-generation systems in Buildings

TOTAL :45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Familiar with climate responsive building design and basic concepts
2. Explain the basic terminologies related to buildings
3. Discuss the energy efficient air conditioning techniques
4. Evaluate the performance of buildings
5. Gets acquainted with Renewable energy systems in buildings

TEXT BOOKS

1. Advanced Decision Making for HVAC Engineers, by Javad Khazaii, Springer; Softcover reprint of the original 1st ed. 2016 edition (23 June 2018), ISBN-10: 3319814869
2. Thermal Comfort and Energy-Efficient Cooling of Non-residential Buildings, by Doreen E. Kalz, Jens Pfafferott, Springer; 2014th edition (8 April 2014), ISBN-10 : 9783319045818.

REFERENCES

1. ASHRAE Handbook – Fundamentals / Equipment's/ Applications – ASHRAE 2021,2020, 2019 Editions

2. Baruch Givoni: Climate considerations in building and Urban Design, John Wiley & Sons, 1998
3. Baruch Givoni: Passive Low Energy Cooling of Buildings by, John Wiley & Sons, 15-Jul-1994
4. JA Duffie and WA Beckman: Solar Engineering of Thermal Processes, Third Edition, John Wiley & Sons, 2006.
5. Jan F. Kreider, Peter S. Curtiss, Ari Rabl, Heating and Cooling of buildings: Design for Efficiency, Revised Second Edition, CRC Press, 28-Dec-2009.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	–	–	–	1	–	–	2	–	2	2	2	1
CO2	3	3	2	1	1	–	2	–	–	2	–	2	3	2	2
CO3	3	3	2	1	–	–	2	1	–	2	–	2	3	2	2
CO4	3	3	3	2	1	1	3	2	–	3	–	3	3	3	3
CO5	2	2	2	1	2	–	2	2	–	2	–	2	2	2	2
Avg.	**3**	**3**	**2**	**1**	**1**	1	**2**	**1**	–	**2**	–	**2**	**3**	**2**	**2**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3056 ENERGY CONSERVATION AND MANAGEMENT

L	T	P	C
3	**0**	**0**	**3**

COURSE OBJECTIVES

1. To understand and analyse the energy data of industries
2. To carryout energy accounting and balancing
3. To conduct energy audit and suggest methodologies for energy savings
4. To utilise the available resources in optimal ways
5. To apply principles of energy economics

UNIT I INTRODUCTION 9

Energy - Power – Past & Present scenario of World; National Energy consumption Data – Environmental aspects associated with energy utilization – Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Instruments for energy auditing.

UNIT II ELECTRICAL SYSTEMS 9

Components of EB billing – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors - Motor Efficiency Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination.

UNIT III THERMAL SYSTEMS 9

Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation and encon measures. Steam: Distribution &U sage: Steam Traps, Condensate Recovery, Flash Steam Utilization, Insulators & Refractories.

UNIT IV ENERGY CONSERVATION IN MAJOR UTILITIES 9

Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems –Cooling Towers – D.G. sets.

UNIT V ECONOMICS 9

Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concept.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Remember the knowledge for Basic combustion and furnace design and selection of thermal and mechanical energy equipment.
2. Study the Importance of Stoichiometry relations, Theoretical air required for complete combustion.
3. Skills on combustion thermodynamics and kinetics.
4. Apply calculation and design tube still heaters.
5. Practical and theoretical knowledge burner design and studied different heat treatment furnace.

TEXT BOOKS

1. Energy Manager Training Manual (4 Volumes) available at www.energymanagertraining.com. A website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004.

REFERENCES

1. Witte. L.C., P.S. Schmidt, D.R. Brown, “Industrial Energy Management and Utilisation” Hemisphere Publ, Washington, 1988.
2. Callaghn, P.W. “Design and Management for Energy Conservation”, Pergamon Press, Oxford, 1981
3. Dryden. I.G.C., “The Efficient Use of Energy” Butterworths, London, 1982
4. Turner. W.C., “Energy Management Hand book”, Wiley, New York, 1982
5. Murphy. W.R. and G. Mc KAY, “Energy Management”, Butterworths, London 1987

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	1	2	1	1	1	2	2	3	2	2
CO2	3	2	2	2	1	2	2	-	2	2	2	2	3	2	2
CO3	3	2	2	2	1	2	2	-	2	2	3	3	3	2	2
CO4	3	2	2	2	2	2	2	1	2	2	3	3	3	2	2
CO5	3	2	2	2	2	2	2	1	2	2	3	3	3	2	2
Avg.	**3**	**2**	**2**	**2**	**1**	**2**	**2**	**1**	**2**	**2**	**3**	**3**	**3**	**2**	**2**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3057 **CARBON FOOTPRINT ESTIMATION AND REDUCTION TECHNIQUES**

L	T	P	C
3	**0**	**0**	**3**

COURSE OBJECTIVES

1. To introduce climate change and carbon footprint
2. To study the principle of product life cycle and Green House Gas emissions accounting
3. To study the Methodology for Carbon Footprint Calculation
4. To learn emission mitigation and carbon sink
5. To study the case study of carbon footprint.

UNIT I CLIMATE CHANGE AND CARBON FOOTPRINT 9

Green House Effect and Climate Change - Causes and Impacts of Climate Change – Economic implications of Climate Change -IPCC Reports and Projected Climate Change Scenarios – Green House Gas (GHG) Emission – Carbon footprint of Activities, Processes, Products and Services of Organisations – GHG Emission factors and Calculations

UNIT II PRODUCT LIFE CYCLE AND GHG EMISSIONS 9

Life-cycle GHG Accounting - Principles of Product Life Cycle GHG Accounting and Reporting - Fundamentals of Product Life Cycle GHG Accounting - Establishing the Scope of a Product Inventory- GHG Emission Inventories and Accounting - Collecting Data and Assessing Data Quality Allocation and Assessing Uncertainty

UNIT III METHODOLOGICAL ASPECTS OF CARBON FOOTPRINT 9

Methodology for Carbon Footprint Calculation in Crop and Livestock Production, End of Life Scenarios and Carbon Footprint of Wood Cladding, Carbon Footprints and Greenhouse Gas Emission Savings of Alternative Synthetic Biofuels, Making Food Production GHG Efficient, Carbon Footprint of Wood-Based Products and Buildings, Challenges and Merits of Choosing Alternative Functional Units, modeling aspects of carbon footprint, Quantifying Spatial–Temporal Variability of Carbon Stocks and Fluxes

UNIT IV EMISSION MITIGATION AND CARBON SINK 9

Setting GHG Reduction Targets and Tracking Inventory Changes – Non-Fossil Fuel based Energy Systems - Carbon Dioxide capture and Storage Technologies –Mitigation potentials of different Sectors and systems – Innovation, Technology Development and Transfer, - Social aspects of mitigation –Policies, Institutions and international corporations – Carbon Pricing and Finance –GHG Offsetting and Green marketing.

UNIT V CASE STUDIES 9

Carbon Footprint Estimation from Building Sector - Urban Carbon Footprint Evaluation – Applications of carbon footprint in urban planning – Mechanical Equipment and Electronic Product Carbon Footprint - Carbon Footprint of Aqua and Agriculture products- GHG Emissions from Municipal Wastewater Treatment and Solid waste management.

TOTAL:45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Explain the climate change and carbon footprint
2. Discuss the principle of product life cycle and Green House Gas emissions accounting
3. Explain the Methodology for Carbon Footprint Calculation
4. Discuss emission mitigation and carbon sink
5. Explain the case study of carbon footprint.

TEXT BOOKS

1. Assessment of Carbon Footprint in Different Industrial Sectors, Volume 1, by Subramanian Senthilkannan Muthu, Springer; Softcover reprint of the original 1st ed. 2014 edition (23 August 2016), ISBN-10: 9811011737
2. Assessment of Carbon Footprint in Different Industrial Sectors, Volume 2, by Subramanian Senthilkannan Muthu, Springer Nature; 2014th edition (30 April 2014), ISBN-10: 9814585742

REFERENCES

1. Subramanian, Senthil Kannan, Muthu (2016), Carbon Foot Print Handbook, CRC Press
2. Subramanian, Senthil Kannan, Muthu (2016), Environmental Carbon Foot Print Industrial case Studies, Butterworth Heinemann Publishers
3. World Resources Institute, Green House Gas Protocol - Product Life Cycle Accounting and Reporting Standard
4. ISO 14067 -2018, Green House gases and carbon footprint, Requirements and Guidelines for Quantification, International Organisation for Standardisation.
5. IPCC (2022) –Sixth Assessment Reports – Intergovernmental Panel on Climate Change, United Framework convention on Climate Change.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	–	–	–	2	–	–	2	–	2	2	2	1
CO2	3	3	3	1	1	–	2	–	–	2	–	2	3	3	2
CO3	3	3	3	1	1	–	3	1	–	2	–	3	3	3	2
CO4	3	3	3	2	2	–	3	2	–	3	–	3	3	3	3
CO5	2	2	2	1	1	–	2	2	–	2	–	2	2	2	2
Avg.	**3**	**3**	**3**	**1**	**1**	–	**3**	**1**	–	**2**	–	**2**	**3**	**3**	**2**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3058 SOLAR ENERGY APPLICATIONS

L	T	P	C
3	**0**	**0**	**3**

COURSE OBJECTIVE

1. To give students a basic understanding of solar cells, solar lighting systems, and their applications in rural electrification.
2. To provide basic knowledge of solar cookers, their types, working, performance evaluation, and practical applications.
3. To introduce students to solar furnaces, their types, components, and design principles for effective solar concentration.
4. To give students basic knowledge of desalination methods, especially solar-based systems, and their practical importance.
5. To introduce students to the principles, operation, and efficiency improvement methods of solar-pumped lasers and their applications.

UNIT I SOLAR LIGHTING 9

Solar cell – Working principle of a solar cell – Solar home lighting systems – Solar Street lighting systems - Solar lanterns – Applications - Rural electrification process – Case studies

UNIT II SOLAR COOKING 9

Introduction – Types of solar cookers – Advantages and disadvantages - Box type – Parabolic dish cooker - Performance evaluation of solar cookers – Testing of a solar cooker – Applications of solar cooking – Institutional Solar cookers – Solar cooking promoters – Case studies.

UNIT III SOLAR FURNACE 9

Introduction – Types of solar furnaces – Components of solar furnaces – Concentrator – Heliostat – Sun tracking – Typical solar furnace designs – Single concentrator furnace – Single heliostat solar furnace - Multiple heliostats solar furnace - Case studies on solar furnaces.

UNIT IV SOLAR DESALINATION 9

Introduction – Necessity for desalination – Study on various desalination techniques – Comparison between conventional and solar desalination – Basics of solar still - Simple solar still– Material problems in solar still – Solar disinfection and its methods – Case studies on various desalination techniques.

UNIT V SOLAR LASER 9

Solar-pumped solid-state laser theory - solar pumped Nd:YAG laser principle and operation, laser material selection, multi-mode solar pumped laser technology, high brightness solar pumped lasers, solar tracking errors in solar pumped laser – methods to improve efficiency, applications

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Familiar with concepts of solar home lighting and solar street lighting systems.
2. Identify the solar cooker technologies for suitable applications.
3. Design solar furnace of a known rating capacity
4. Aware about various desalination techniques and material problems in solar still
5. Apply the principles of solar-pumped laser and critically analyze the system

TEXT BOOKS

1. Rai, G.D., Solar Energy Utilization, Khanna Publishers, Delhi, 2010.
2. John A. Duffie & William A. Beckman, Solar Engineering of Thermal Processes, Wiley
3. John Twidell & Tony Weir, Renewable Energy Resources, Routledge

REFERENCES

1. Suhatme and Nayak, Solar Energy: Principles of Thermal Collection and Storage, Tata McGraw Hill, 2008.
2. HP Garg and J Prakash: Solar Energy: Fundamentals and Applications, Tata McGraw Hill, 2010.
3. Michael Grupp, Time to Shine: Applications of Solar Energy Technology, John Wiley &Sons, 2012.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	1	-	-	-	-	3	3	3	2	2
CO2	3	3	3	3	2	1	-	-	-	-	2	2	3	2	2
CO3	3	3	3	3	2	1	-	-	-	-	3	3	3	2	2
CO4	3	3	3	3	2	1	-	-	-	-	3	3	3	2	2
CO5	3	3	3	3	2	1	-	-	-	-	3	3	3	2	2
Avg.	**3**	**3**	**3**	**3**	**2**	**1**	-	-	-	-	**3**	**3**	**3**	2	2

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

VERTICAL 6: INDUSTRIAL ENGINEERING

24ME3061 INDUSTRIAL MANAGEMENT

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. To help students understand the basic ideas of management, different management approaches, major contributors, business organization types, and the role of trade unions
2. To enable students to learn how planning, organizing, and staffing are carried out in professional organizations.
3. To help students apply the functions of leading, controlling, communication, and decision-making in management situations
4. To help students understand organizational theories, motivation models, conflict handling, and change management.
5. To enable students to apply productivity concepts and modern management tools like BPR, benchmarking, SWOT/SWOC, TPM, ERP, and MIS in organizations.

UNIT I INTRODUCTION TO MANAGEMENT 9

Management: Introduction; Definition and Functions – Approaches to the study of Management – Mintzberg's Ten Managerial Roles – Principles of Taylor; Fayol; Weber; Parker – Forms of Organization: Sole Proprietorship; Partnership; Company (Private and Public); Cooperative – Public Sector Vs Private Sector Organization – Business Environment: Economic; Social; Political; Legal – Trade Union: Definition; Functions; Merits & Demerits.

UNIT II FUNCTIONS OF MANAGEMENT – I 9

Planning: Characteristics; Nature; Importance; Steps; Limitation; Planning Premises; Strategic Planning; Vision & Mission statement in Planning– Organizing: Organizing Theory; Principles; Types; Departmentalization; Centralization and Decentralization; Authority & Responsibility – Staffing: Systems Approach; Recruiting and Selection Process; Human Resource Development (HRD) Concept and Design.

UNIT III FUNCTIONS OF MANAGEMENT – II 9

Directing (Leading): Leadership Traits; Style; Morale; Managerial Grids (Blake-Mounton, Reddin) – Communication: Purpose; Model; Barriers – Controlling: Process; Types; Levels; Guidelines; Audit (External, Internal, Merits); Preventive Control – Decision Making: Elements; Characteristics; Nature; Process; Classifications.

UNIT IV ORGANIZATION THEORY 9

Organizational Conflict: Positive Aspects; Individual; Role; Interpersonal; Intra Group; Inter Group; Conflict Management – Maslow's hierarchy of needs theory; Herzberg's motivation-hygiene theory; McClelland's three needs motivation theory; Vroom's valence-expectancy

theory – Change Management: Concept of Change; Lewin's Process of Change Model; Sources of Resistance; Overcoming Resistance; Guidelines to managing Conflict.

UNIT V PRODUCTIVITY AND MODERN TOPICS 9

Productivity: Concept; Measurements; Affecting Factors; Methods to Improve – Modern Topics (concept, feature/characteristics, procedure, merits and demerits): Business Process Reengineering (BPR); Benchmarking; SWOT/SWOC Analysis; Total Productive Maintenance; Enterprise Resource Planning (ERP); Management of Information Systems (MIS).

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Explain basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.
2. Discuss the planning; organizing and staffing functions of management in professional organization.
3. Apply the leading; controlling and decision-making functions of management in professional organization.
4. Discuss the organizational theory in professional organization.
5. Apply principles of productivity and modern concepts in management in professional organization.

TEXT BOOKS

1. M. Govindarajan and S. Natarajan, "Principles of Management", Prentice Hall of India, New Delhi, 2009.
2. Koontz. H. and Weihrich. H., "Essentials of Management: An International Perspective", 8th Edition, Tata McGrawhill, New Delhi, 2010.

REFERENCES

1. Joseph J, Massie, "Essentials of Management", 4th Edition, Pearson Education, 1987.
2. Saxena, P. K., "Principles of Management: A Modern Approach", Global India Publications, 2009.
3. S.Chandran, "Organizational Behaviours", Vikas Publishing House Pvt. Ltd., 1994.
4. Richard L. Daft, "Organization Theory and Design", South Western College Publishing, 11th Edition, 2012.
5. S. TrevisCerto, "Modern Management Concepts and Skills", Pearson Education, 2018.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	2	3	2	2	2	2	2	1	1	1
CO2	2	2	1	1	1	2	2	3	2	3	2	2	1	1	1
CO3	2	2	1	1	2	2	2	3	3	3	2	2	1	1	2
CO4	1	1	1	1	1	2	3	2	2	2	2	2	1	1	1
CO5	2	2	1	1	2	2	2	2	2	3	2	2	1	1	2
Avg.	**2**	**2**	**1**	**1**	**2**	**2**	**3**	**2**	**2**	**3**	**2**	**2**	**1**	**1**	**2**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3062 PRODUCTION PLANNING AND CONTROL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. To understand the concept of production planning and control act work study,
2. To apply the concept of product planning,
3. To analyze the production scheduling,
4. To apply the Inventory Control concepts.
5. To prepare the manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

UNIT I INTRODUCTION 9

Objectives and benefits of planning and control-Functions of production control-Types of production- job- batch and continuous-Product development and design-Marketing aspect - Functional aspects- Operational aspect - Durability and dependability aspect aesthetic aspect. Profit consideration- Standardization, Simplification & specialization- Break even analysis-Economics of a new design.

UNIT II WORK STUDY 9

Method study, basic procedure-Selection-Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study – work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards.

UNIT III PRODUCT PLANNING AND PROCESS PLANNING 9

Product planning-Extending the original product information-Value analysis-Problems in lack of product planning-Process planning and routing-Pre requisite information needed for process planning- Steps in process planning-Quantity determination in batch production-Machine capacity, balancing- Analysis of process capabilities in a multi-product system.

UNIT IV PRODUCTION SCHEDULING 9

Production Control Systems-Loading and scheduling-Master Scheduling-Scheduling rules-Gantt charts-Perpetual loading-Basic scheduling problems - Line of balance – Flow production scheduling- Batch production scheduling-Product sequencing – Production Control systems-Periodic batch control-Material requirement planning kanban – Dispatching-Progress reporting and expediting- Manufacturing lead time-Techniques for aligning completion times and due dates.

UNIT V INVENTORY CONTROL AND RECENT TRENDS IN PPC 9

Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system - Ordering cycle system-Determination of Economic order quantity and economic lot size- ABC analysis - Recorder procedure-Introduction to computer integrated production planning systems- elements of Just In Time systems-Fundamentals of MRP II and ERP.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. The students can able to prepare production planning and control act work study,
2. The students can able to prepare product planning,
3. The students can able to prepare production scheduling,
4. The students can able to prepare Inventory Control.
5. They can plan manufacturing requirements manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

TEXT BOOKS

1. James. B. Dilworth, Operations management – Design, Planning and Control for manufacturing and services" Mcgraw Hill International edition 1992.
2. Martand Telsang, "Industrial Engineering and Production Management", First edition, S. Chand and Company, 2000.

REFERENCES

1. Chary. S.N., "Theory and Problems in Production & Operations Management", Tata McGraw Hill, 1995.
2. Elwood S.Buffa, and Rakesh K.Sarin, "Modern Production / Operations Management", 8th Edition John Wiley and Sons, 2000
3. Jain. K.C. & Aggarwal. L.N., "Production Planning Control and Industrial Management", Khanna Publishers, 1990
4. Kanishka Bedi, "Production and Operations management", 2nd Edition, Oxford university press, 2007.
5. Melynk, Denzler, "Operations management – A value driven approach" Irwin Mcgraw hill.

6. Norman Gaither, G. Frazier, “Operations Management” 9th Edition, Thomson learning IE, 2007
7. Samson Eilon, “Elements of Production Planning and Control”, Universal Book Corpn.1984
8. Upendra Kachru, “Production and Operations Management – Text and cases” 1st Edition, Excel books 2007

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	3	1	1	2	2	3	2	2	2	2	3
CO2	2	2	2	2	3	1	1	2	2	3	2	2	2	2	3
CO3	2	2	2	2	3	1	1	2	2	3	2	2	2	2	3
CO4	2	2	2	2	3	1	1	2	2	3	2	2	2	2	3
CO5	2	2	2	2	3	1	1	2	2	3	2	2	2	2	3
Avg.	**2**	**2**	**2**	**2**	**3**	**1**	**1**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**3**

“1” - low, “2” - medium, “3” - high, “-” - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3063 PROCESS PLANNING AND COST ESTIMATION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. To introduce the process planning concepts to make cost estimation for various products after process planning.
2. To Learn the various Process Planning Activities.
3. To provide the knowledge of importance of costing and estimation.
4. To provide the knowledge of estimation of production costing.
5. To learn the knowledge of various Machining time calculations.

UNIT I INTRODUCTION TO PROCESS PLANNING 9

Introduction- methods of process planning-Drawing Interpretation-Material evaluation – steps in process selection-. Production equipment and tooling selection.

UNIT II PROCESS PLANNING ACTIVITIES 9

Process parameters calculation for various production processes-Selection jigs and fixture selection of quality assurance methods - Set of documents for process planning-Economics of process planning- case studies.

UNIT III INTRODUCTION TO COST ESTIMATION 9

Importance of costing and estimation –methods of costing-elements of cost estimation –Types of estimates – Estimating procedure- Estimation labour cost, material cost- allocation of overhead charges- Calculation of depreciation cost.

UNIT IV PRODUCTION COST ESTIMATION 9

Estimation of Different Types of Jobs - Estimation of Forging Shop, Estimation of Welding Shop, Estimation of Foundry Shop.

UNIT V MACHINING TIME CALCULATION 9

Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations, Drilling and Boring - Machining Time Calculation for Milling, Shaping and Planning -Machining Time Calculation for Grinding.

TOTAL :45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Discuss select the process, equipment and tools for various industrial products.
2. Explain the prepare process planning activity chart.
3. Explain the concept of cost estimation.
4. Compute the job order cost for different type of shop floor.
5. Calculate the machining time for various machining operations.

TEXT BOOKS

1. Peter scalon, “Process planning, Design/Manufacture Interface”, Elsevier science technology Books, Dec 2002.
2. Sinh a B.P, “Mechanical Estimating and Costing”, Tata-McGraw Hill publishing co, 1995.

REFERENCES

1. Chitale A.V. and Gupta R.C., “Product Design and Manufacturing”, 2nd Edition, PHI, 2002.
2. Ostwalal P.F. and Munez J., “Manufacturing Processes and systems”, 9th Edition, John Wiley,1998.
3. Russell R.S and Tailor B.W, “Operations Management”, 4th Edition, PHI, 2003.
4. Mikell P. Groover, “Automation, Production, Systems and Computer Integrated Manufacturing”, Pearson Education 2001.
5. K.C. Jain & L.N. Aggarwal, “Production Planning Control and Industrial Management”, Khanna Publishers 1990.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	2	–	1	–	–	1	–	1	1	2	1	1
CO2	3	1	2	1	–	1	–	–	1	–	1	1	2	1	1
CO3	3	2	2	2	–	1	–	–	1	–	1	1	2	1	1
CO4	3	2	2	2	–	1	–	1	1	–	1	1	2	1	1
CO5	2	2	2	2	–	1	–	1	1	–	1	1	2	1	1

Avg.	**3**	**2**	**2**	**2**	**–**	**1**	**–**	**1**	**1**	**–**	**1**	**1**	**2**	**1**	**1**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3064 QUALITY ENGINEERING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. Developing a clear knowledge in the basics of various quality concepts.
2. Facilitating the students in understanding the application of control charts and its techniques.
3. Developing thespecialcontrolproceduresforserviceandprocessorientedindustries.
4. Analyzing and understanding the process capability study.
5. Developing the acceptance sampling procedures for incoming raw material.

UNIT I INTRODUCTION 9

Quality Dimensions–Quality definitions–Inspection-Quality control–Quality Assurance–Quality Planning-Quality costs–Economics of quality– Quality loss function

UNIT II CONTROL CHARTS 9

Chance and assignable causes of process variation, statistical basis of the control chart, control charts for variables- *X,* R and S charts, attribute control charts - p, np, c and u- Construction and application.

UNIT III SPECIAL CONTROL PROCEDURES 9

Warning and modified control limits, control chart for individual measurements, multi-vari chart, *X* chart with a linear trend, chart for moving averages and ranges, cumulative-sum and exponentially weighted moving average control charts.

UNIT IV STATISTICAL PROCESS CONTROL 9

Process stability, process capability analysis using a Histogram or probability plots and control chart. Gauge capability studies, setting specification limits.

UNIT V ACCEPTANCE SAMPLING 9

The acceptance sampling fundamental, OC curve, sampling plans for attributes, simple, double, multiple and sequential, sampling plans for variables, MIL-STD-105D and MIL-STD-414E & IS2500 standards.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Control the quality of processes using control charts for variables in manufacturing industries.
2. Control the occurrence of defective product and the defects in manufacturing companies.
3. Control the occurrence of defects in services.
4. Analyzing and understanding the process capability study.
5. Developing the acceptance sampling procedures for incoming raw material.

TEXT BOOKS

1. Douglas C. Montgomery, Introduction to Statistical Quality Control, 7th Edition, Wiley, 2012.
2. Grant, E. L. & Leavenworth, R. S. Statistical Quality Control, 7th Edition, McGraw-Hill, 2012.

REFERENCES

1. Juran, J. M. & Gryna, F. M. Quality Planning and Analysis, McGraw-Hill, 5th Edition.
2. Amitava Mitra, Fundamentals of Quality Control and Improvement, 4th Edition, Wiley, 2016.
3. K. Subburaj, Total Quality Management, Tata McGraw-Hill.
4. Mahajan, M., Statistical Quality Control, Dhanpat Rai Publications.
5. Besterfield, Dale H., Quality Control, Pearson Education.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	1	1	1	1	2	2	2	3	3	3
CO2	3	3	2	3	3	2	1	1	1	2	2	2	3	3	3
CO3	2	2	2	2	2	2	1	1	1	2	2	2	2	2	2
CO4	3	3	2	3	3	1	1	1	1	2	2	3	3	3	3
CO5	3	3	2	3	3	1	1	1	1	2	2	3	3	3	3
Avg.	**3**	**3**	**2**	**3**	**3**	**2**	**1**	**1**	**1**	**2**	**2**	**3**	**3**	**3**	**3**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3065 PRODUCT LIFE CYCLE MANAGEMENT

L	T	P	C
3	**0**	**0**	**3**

COURSE OBJECTIVES

1. To study about the history, concepts and terminology in PLM
2. To learn the functions and features of PLM / PDM

3. To develop different modules offered in commercial PLM / PDM tools
4. To demonstrate PLM / PDM approaches for industrial applications
5. To use PLM / PDM with legacy data bases, Coax& ERP systems

UNIT I HISTORY, CONCEPTS AND TERMINOLOGY 9

Introduction to PLM, Need for PLM, opportunities of PLM, Different views of PLM - Engineering Data Management (EDM), Product Data Management (PDM), Collaborative Product Definition Management (cPDm), Collaborative Product Commerce (CPC), Product Lifecycle Management (PLM). PLM / PDM Infrastructure – Network and Communications, Data Management, Heterogeneous data sources and applications

UNIT II PLM / PDM FUNCTIONS AND FEATURES 9

User Functions – Data Vault and Document Management, Workflow and Process Management, Product Structure Management, Product Classification and Programme Management. Utility Functions – Communication and Notification, data transport, data translation, image services, system administration and application integration

UNIT III DETAILS OF MODULES IN A PDM / PLM SOFTWARE 9

Case studies based on top few commercial PLM/PDM tools – Teamcenter, Windchill, ENOVIA, Aras PLM, SAP PLM, Arena, Oracle Agile PLM and Autodesk Vault. -Architecture of PLM software- selection criterion of software for particular application - Brand name to be removed

UNIT IV ROLE OF PLM IN INDUSTRIES 9

Case studies on PLM selection and implementation (like auto, aero, electronic) - other possible sectors, PLM visioning, PLM strategy, PLM feasibility study, change management for PLM, financial justification of PLM, barriers to PLM implementation, ten step approach to PLM, benefits of PLM for–business, organisation, users, product or service, process performance-process compliance and process automation

UNIT V BASICS ON CUSTOMISATION/INTEGRATION OF PDM / PLM SOFTWARE 9

PLM Customization, use of EAI technology (Middleware), Integration with legacy data base, CAD, SLM and ERP

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Summarize the history, concepts and terminology of PLM
2. Develop the functions and features of PLM / PDM
3. Discuss different modules offered in commercial PLM/PDM tools.
4. Interpret the implement PLM / PDM approaches for industrial applications.

5. Integrate PLM / PDM with legacy data bases, CAx & ERP systems

TEXT BOOKS

1. Product Lifecycle Management for a Global Market, Springer; 2014 edition (29 September 2016), ISBN-10: 3662516330
2. Product Life Cycles and Product Management, Praeger Publishers Inc (27 March 1989) ISBN-10: 0899303196

REFERENCES

1. Antti Saaksvuori and Anselmi Immonen, "Product Lifecycle Management", Springer Publisher, 2008 (3rd Edition)
2. Ivica Crnkovic, Ulf Asklund and Annita Persson Dahlqvist, "Implementing and Integrating Product Data Management and Software Configuration Management", Artech House Publishers, 2003.
3. John Stark, "Global Product: Strategy, Product Lifecycle Management and the Billion Customer Question", Springer Publisher, 2007
4. John Stark, "Product Lifecycle Management: 21st Century Paradigm for Product Realisation", Springer Publisher, 2011 (2nd Edition).
5. Michael Grieves, "Product Life Cycle Management", Tata McGraw Hill, 2006.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	2	1	1	1	1	2	1	2	2	2	2
CO2	3	2	2	2	3	1	1	1	1	2	1	2	3	2	3
CO3	2	2	2	2	3	1	1	1	1	2	1	2	3	2	3
CO4	3	3	2	2	3	1	1	1	1	3	2	3	3	3	3
CO5	3	2	2	2	3	1	1	1	1	3	2	3	3	3	3
Avg.	**3**	**2**	**2**	**2**	**3**	**1**	**1**	**1**	**1**	**3**	**2**	**2**	**3**	**3**	**3**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3066 ENGINEERING ECONOMICS

L	T	P	C
3	**0**	**0**	**3**

COURSE OBJECTIVES

1. To help students understand basic economic concepts and cost analysis used in engineering.
2. To teach students value engineering, make-or-buy decisions, and the use of interest formulas and time value of money.

3. To help students learn how to compare different cash flow alternatives for engineering decisions.
4. To teach students how to analyze when to replace or maintain equipment and find its economic life.
5. To help students understand different depreciation methods and make decisions that include inflation effects.

UNIT I INTRODUCTION TO ECONOMICS 8

Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics - Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis - V ratio, Elementary economic Analysis – Material selection for product Design selection for a product, Process planning.

UNIT II VALUE ENGINEERING 10

Make or buy decision, Value engineering – Function, aims, Value engineering procedure. Interest formulae and their applications –Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor - Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods.

UNIT III CASH FLOW 9

Methods of comparison of alternatives – present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, Examples in all the methods.

UNIT IV REPLACEMENT AND MAINTENANCE ANALYSIS 9

Replacement and Maintenance analysis – Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset – capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.

UNIT V DEPRECIATION 9

Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation-Sum of the years digits method of depreciation, sinking fund method of depreciation/ Annuity method of depreciation, service output method of depreciation-Evaluation of public alternatives- introduction, Examples, Inflation adjusted decisions – procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Understand basic economics, costs, and supply–demand concepts for engineering decisions.
2. Use value engineering, make-or-buy decisions, and interest formulas to solve problems.
3. Compare different engineering alternatives using cash flow methods.
4. Determine when to replace equipment and calculate its economic life.
5. Apply depreciation and inflation-adjusted methods for economic decision-making.

TEXT BOOK

1. Panneer Selvam, R, “Engineering Economics”, Prentice Hall of India Ltd, New Delhi, 2001.

REFERENCES

1. Chan S.Park, “Contemporary Engineering Economics”, Prentice Hall of India, 2011.
2. Donald.G. Newman, Jerome.P.Lavelle, “Engineering Economics and analysis” Engg. Press, Texas, 2010.
3. Degarmo, E.P., Sullivan, W.G and Canada, J.R, “Engineering Economy”, Macmillan, NewYork, 2011.
4. Zahid A khan: Engineering Economy, "Engineering Economy", Dorling Kindersley, 2012

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	2	1	1	1	3	1	2	1	1	1
CO2	3	2	2	2	2	2	1	1	1	3	2	2	2	2	2
CO3	3	3	2	2	2	2	1	1	1	3	2	2	2	2	2
CO4	3	3	2	2	2	2	1	1	1	3	2	2	2	2	2
CO5	3	3	2	2	2	2	1	1	1	3	2	2	2	2	2
Avg.	**3**	**3**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**3**	**2**	**2**	**2**	**2**	**2**

“1” - low, “2” - medium, “3” - high, “-” - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3067 OPERATIONAL RESEARCH

L	T	P	C
3	**0**	**0**	**3**

COURSE OBJECTIVES

1. To learn Selecting the constraints on the availability of resources and developing a model and rendering an optimal solution for the given circumstances.

2. To study Appraising the challenges in the transportation and production problems and furnishing a rational solution to maximize the benefits.
3. To learn Planning the purchase/ manufacturing policies, managing the spares/ stocks and meeting the customer demands.
4. To Analysing the queue discipline and exploring the avenues for better customer service.
5. To Investigating the nature of the project and offering methodical assistance towards decision making in maintenance.

UNIT I INTRODUCTION TO OPERATIONS RESEARCH AND LINEAR PROGRAMMING 9

Operation Research: Definition – Models – Steps – Important topics – Scope - Tools. Linear Programming (LP): Introduction – Concept (Problem mix, Assumption, Properties) – Development (Problem formulation) – Problems in: Graphical method, Simplex methods, Big M method.

UNIT II TRANSPORTATION, ASSIGNMENT AND PRODUCTION SCHEDULING PROBLEMS 9

Transportation problems: Introduction, Model, Types – Problems in: Initial Basic (feasible) solution: Northwest Corner Cell method; Least Cost Cell method; Vogel's Approximation method and Optimal solution MODI (U-V) method. Assignment problems: Introduction, Types, Problems in Hungarian method. Production Scheduling problems: Introduction – Problems in Single Machine Scheduling: SPT; WSPT, EDD methods – Problems in Johnson's Algorithm: n job 2 machines, n job 3 machines.

UNIT III INVENTORY CONTROL MODELS & SYSTEMS 9

Inventory Control: Introduction, Models – Problems in Purchase and Production (Manufacturing) models with and without shortages – Theory on types of inventory control systems: P& Q, ABC, VED, FNS, XYZ, SDE and HML.

UNIT IV QUEUING THEORY 9

Queuing Theory: Introduction; Applications; Terminology, Poisson process and exponential distribution – Problems in Single Server and Multi Server Queuing Models –Case study on simulation using Monte Carlo technique.

UNIT V PROJECT MANAGEMENT AND REPLACEMENT MODELS 9

Project Management: Introduction; Guidelines for Networking AOA Diagrams – Problems in Critical Path Method (CPM) & Program Evaluation Review Technique (PERT) – Differences of CPM & PERT. Replacement Problems: Types – Problems in: Determination of Economic Life of an Asset – Problems in: Individual and Group Replacement Policies, Apply OR software

TOTAL :45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Discuss the selection of the constraints on the availability of resources, develop a model and render an optimal solution for the given circumstances.
2. Explain the appraise the challenges in the transportation and production problems and furnish a rational solution to maximize the benefits.
3. Explain plan the purchase/ manufacturing policies, manage the spares/ stocks, and meet the customer demands.
4. Analyze the queue discipline and explore the avenues for better customer service.
5. Investigate the nature of the project and offer methodical assistance towards decision making in maintenance.

TEXT BOOKS

1. Pannerselvam R, "Operations Research", 2nd Edition, PHI, 2009.
2. Hamdy A. Taha, "Operations Research an Introduction", 10th Edition, PHI/Pearson Education, 2017.

REFERENCES

1. Ravindran, Phillips and Solberg, "Operations Research Principles and Practice", 2nd Edition, Wiley India, 2007.
2. Srinivasan G, "Operations Research Principles and Applications", 3rd Edition EEEPHI, 2017.
3. Sharma J K, "Operations Research Theory and Applications",5th Edition, Macmillan India, 2013.
4. Premkumar Gupta and D.S.Hira, "Problems in Operations Research", S. Chand,2009.
5. Wayne L. Winston, "Operations Research Applications and Algorithms", 4th Edition, Cengage Learning, 2004.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	1	1	1	1	2	2	3	3	3	3
CO2	3	3	2	3	3	1	1	1	1	2	2	3	3	3	3
CO3	3	3	2	2	3	2	1	1	1	2	2	2	3	3	3
CO4	3	3	2	2	3	2	1	1	1	2	2	2	3	3	3
CO5	3	3	2	2	3	2	1	1	1	2	2	3	3	3	3
Avg.	**3**	**3**	**2**	**3**	**3**	**2**	**1**	**1**	**1**	**2**	**2**	**3**	**3**	**3**	**3**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3068 **REVERSE ENGINEERING**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. To help students understand the basics, phases, and uses of reverse engineering, including surface and solid model reconstruction.
2. To enable students to study material properties, identify manufacturing processes, and analyze failures in components.
3. To teach students how to process measured data, analyze performance, and evaluate system reliability.
4. To give students knowledge and hands-on understanding of 3D scanning, modelling techniques, and digital reconstruction.
5. To expose students to industrial applications, case studies, and legal aspects related to reverse engineering.

UNIT I INTRODUCTION & GEOMETRIC FORM 9

Definition – Uses – The Generic Process – Phases – Computer Aided Reverse Engineering - Surface and Solid Model Reconstruction – Dimensional Measurement – Prototyping.

UNIT II MATERIAL CHARACTERISTICS AND PROCESS IDENTIFICATION 9

Alloy Structure Equivalency – Phase Formation and Identification – Mechanical Strength – Hardness –Part Failure Analysis – Fatigue – Creep and Stress Rupture – Environmentally Induced Failure Material Specification - Composition Determination - Microstructure Analysis - Manufacturing Process Verification.

UNIT III DATA PROCESSING 9

Statistical Analysis – Data Analysis – Reliability and the Theory of Interference – Weibull Analysis – Data Conformity and Acceptance – Data Report – Performance Criteria – Methodology of Performance Evaluation – System Compatibility.

UNIT IV 3D SCANNING AND MODELLING 9

Introduction, working principle and operations of 3D scanners: Laser, White Light, Blue Light - Applications- Software for scanning and modelling: Types- Applications- Preparation techniques for Scanning objects- Scanning and Measuring strategies - Calibration of 3D Scanner- Step by step procedure: 3D scanning - Geometric modelling – 3D inspection- Case studies.

UNIT V INDUSTRIAL APPLICATIONS 9

Reverse Engineering in the Automotive Industry; Aerospace Industry; Medical Device Industry. Case studies and Solving Industrial projects in Reverse Engineering. Legality: Patent – Copyrights –Trade Secret – Third-Party Materials.

TOTAL :45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Understand the concept, process, and applications of reverse engineering and reconstruct models accurately.
2. Identify material characteristics, analyze failures, and determine the manufacturing process of components.
3. Process and analyze engineering data using statistical and reliability tools for performance evaluation.
4. Use 3D scanning and modelling tools to digitize, reconstruct, and inspect physical components.
5. Apply reverse engineering concepts to real industrial problems and understand legal issues such as patents and copyrights.

TEXT BOOKS

1. Robert W. Messler, Reverse Engineering: Mechanisms, Structures, Systems & Materials, 1st Edition, McGraw-Hill Education, 2014
2. Wego Wang, Reverse Engineering Technology of Reinvention, CRC Press, 2011

REFERENCES

1. Scott J. Lawrence, Principles of Reverse Engineering, Kindle Edition, 2022
2. Kevin Otto and Kristin Wood, Product Design: Techniques in Reverse Engineering and New Product Development, Prentice Hall, 2001
3. Kathryn, A. Ingle, “Reverse Engineering”, McGraw-Hill, 1994.
4. Linda Wills, “Reverse Engineering”, Kluver Academic Publishers, 1996
5. Vinesh Raj and Kiran Fernandes, “Reverse Engineering: An Industrial Perspective”, Springer-Verlag London Limited 2008.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	1	1	1	1	2	1	2	3	2	3
CO2	3	3	2	3	2	2	1	1	1	2	1	2	3	3	3
CO3	3	3	2	3	2	1	1	1	1	2	2	2	3	3	3
CO4	3	2	2	2	3	1	1	1	1	2	1	2	3	2	3
CO5	2	2	1	1	1	2	3	1	1	2	2	2	2	2	2
Avg.	**3**	**3**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**2**	**2**	**2**	**3**	**3**	**3**

“1” - low, “2” - medium, “3” - high, “-” - no correlation

Note: The average value of this course to be used for program articulation matrix.

VERTICAL 7: SAFETY ENGINEERING

24ME3071 BASICS OF SAFETY ENGINEERING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. To analyze the principles of safety management
2. To apply knowledge about various functions and activities in an organization.
3. To conduct safety audit and write audit report effectively in auditing situations.
4. To implement knowledge about sources of information for safety promotion and training
5. To Employ evaluation of safety performance.

UNIT I INTRODUCTION AND NEEDS OF SAFETY 9

Introduction-Safety-Goals of safety engineering. Need for safety. Safety and productivity. Definitions: Accident, Injury, Unsafe act, Unsafe Condition, Dangerous Occurrence, Reportable accidents. Theories of accident causation.

UNIT II SAFETY ORGANIZATION INTRODUCTION 9

Safety organization- objectives, types, functions, Role of management, supervisors, workmen, unions, government and voluntary agencies in safety. Safety policy. Safety Officer-responsibilities, authority. Safety committee-needs, types, advantages. Accident prevention Methods-Engineering, Education and Enforcement

UNIT III SAFETY EDUCATION AND TRAINING 9

Safety Education & Training-Importance, Various training methods, Effectiveness of training, Behaviour oriented training. Communication- purpose, barrier to communication. Housekeeping: Responsibility of management and employees. Advantages of good housekeeping. 5s of housekeeping. Work permit system-objectives, hot work and cold work permits. Typical industrial models and methodology. Entry into confined spaces.

UNIT IV SAFETY PERFORMANCE MONITORING 9

Personal protection in the work environment, Types of PPEs, Personal protective equipment respiratory and non-respiratory equipment. Standards related to PPEs. Monitoring Safety Performance: Frequency rate, severity rate, incidence rate, activity rate. Cost of accidents – Computation of Costs-Utility of Cost data. Plant safety inspection, types, inspection procedure. Safety sampling techniques. Job safety analysis (JSA), Safety surveys, and Safety audits. Safety Inventory Technique.

UNIT V ACCIDENT INVESTIGATION AND REPORTING 9

Accident investigation- Why? When? Where? Who? and how? Basics- Man- Environment and Systems. Process of Investigation -Tools-Data Collection- Handling witnesses- Case study. Accident analysis- MORT-Multi Events Sequencing-TOR.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Analyse the functions and activities of safety engineering department.
2. Carry out a safety audit and prepare a report for the audit
3. Prepare an accident investigation report.
4. Estimate the accident cost using supervisors report and data.
5. Use identification of various agencies, support in situation and government organizations involved in safety training and promotion

TEXT BOOKS

1. Heinrich H. W., "Industrial Accident Prevention" McGraw-Hill Company, New York, 1969, 4thEdition.
2. Krishnan N.V., "Safety Management in Industry", Jaico Publishing House, Bombay,1997.

REFERENCES

1. Krishnan, N.V. (1997), Safety management in Industry, Jaico Publishing House, New Delhi. Yoram Koren, "Robotics for Engineers", McGraw Hill Book, Co., 2002.
2. John V. Grimaldi and Rollin H. Simonds (1989) Safety management, All India Traveller Book Seller, Delhi.
3. Ronald P. Blake (1973), Industrial safety. Prentice Hall, New Delhi.
4. Alan Waring, (1996), Safety management system, Chapman &Hall, England.
5. Akhil Kumar Das, "Principles of Fire Safety Management" Eastern Economy Edition,2020

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	-	2	-	3	-	2	-	3	2	2	3	-
CO2	1	-	3	-	1	2	3	-	1	2	3	1	-	3	-
CO3	-	2	3	-	-	2	3	-	-	2	3	-	2	3	-
CO4	2	-	3	2	-	1	3	2	-	1	3	2	-	3	2
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Avg.	2	2	3	2	2	2	3	2	2	2	3	2	2	3	2

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3072 OCCUPATIONAL HEALTH AND HYGIENE

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. Examine identification of various agencies, support in situations and government organizations involved in safety training and promotion.
2. Apply measurement procedures to monitor exposure to various chemical hazards.
3. Implement safety practices based on biological and ergonomical hazards with their effects.
4. Analyse occupational risks addressed by occupational health services.
5. Implement workplace practices using knowledge of occupational physiology.

UNIT I PHYSICAL HAZARDS 9

Noise, compensation aspects, noise exposure regulation, properties of sound, occupational damage, risk factors, sound measuring instruments, octave band analyzer, noise networks, noise surveys, noise control program, industrial audiometry. Vibration, types, effects, instruments, permissible exposure limit.

Recognition, evaluation and control of physical hazards. Vibration - description and measurement of vibration. Vibration control methods. Effects of whole-body vibration on human body and control measures.

Ionizing radiation and non-ionizing radiation- types, effects and monitoring instruments. Early recognition of radiation hazard. Personal monitoring devices, Medical support. Hazards associated with the following radiations and preventive measures- Laser, infra-red, ultra violet and ELF.

UNIT II CHEMICAL HAZARDS 9

Recognition of chemical hazards-dust, fumes, mist, vapour, fog, gases, types, concentration, Exposure vs. dose, TLV - Methods of Evaluation, process or operation description, Field Survey, Sampling methodology, Industrial Hygiene calculations, Comparison with OSHAS Standard.

Air Sampling instruments, Types, Measurement Procedures, Instruments Procedures, Gas and Vapour monitors, dust sample collection devices, personal sampling

Methods of Control - Engineering Control, Design maintenance considerations, design specifications - General Control Methods - training and education.

UNIT III BIOLOGICAL AND ERGONOMICAL HAZARD 9

Classification of Biohazardous agents – examples, bacterial agents, rickettsial and chlamydial agents, viral agents, fungal, parasitic agents, infectious diseases - Biohazard control program, employee health program-laboratory safety program-animal care and handling-biological safety cabinets - building design.

Work Related Musculoskeletal Disorders –carpal tunnel syndrome CTS- Tendon pain-disorders of the neck- back injuries.

UNIT IV OCCUPATIONAL HEALTH AND TOXICOLOGY 9

Concept and spectrum of health - functional units and activities of occupational health services, pre-employment and post-employment medical examinations - occupational related diseases, levels of prevention of diseases, notifiable occupational diseases such as silicosis, asbestosis, pneumoconiosis, siderosis, anthracosis, aluminosis and anthrax, lead-nickel, chromium and manganese toxicity, gas poisoning (such as CO, ammonia, coal and dust etc) their effects and prevention – cardio pulmonary resuscitation, audiometric tests, eye tests, vital function tests.

Industrial toxicology, local, systemic and chronic effects, temporary and cumulative effects, carcinogens entry into human systems.

UNIT V OCCUPATIONAL AND PSYCHOLOGICAL HAZARDS 9

Elements of Industrial Psychology-Mental Health in Industries- Organisational Behaviour, Motivational Theory, Job Satisfaction Value system, Habits, Drug Abuse-Alcoholism in Industry, Communications, Psychological Hazards - Workplace Stress- General Adaptation

Syndrome Eustress – Distress Diseases / Disorders related to Work stress- Psychosomatic disorders. Managing Work-stress in industry- Individual responsibilities - Employers Responsibilities. Psychological Counselling of employees- Employees Assistance Programme, Behaviour based Safety.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Analyse safety performance using data on physical hazards and their effects.
2. Evaluate the impact of chemical hazards using measured exposure values.
3. Use the identification of biological and ergonomical hazards while planning the design of safety buildings.
4. Implement preventive programs using the identification of occupational diseases and prevention methods.
5. Apply knowledge of physiological functions using appropriate test methods

TEXT BOOKS

1. Goetsch D.L., (1999), Occupational Safety and Health for Technologists, Engineers and Managers, Prentice Hall.
2. Slote. L, Handbook of Occupational Safety and Health, John Willey and Sons, New York

REFERENCES

1. Fundamentals of Industrial Hygiene. 5th Ed. Plog, Barbara and Patricia Quinlain. Chicago, IL: National Safety Council, 2001

2. The industrial environment - its evaluation and control. DHHS (NIOSH) publication number 74- 117, 1973.
3. Clayton, C.D. and Clayton, F. (1981). Pattys industrial hygiene and toxicology. Wiley Inderscience, New York.
4. The Occupational Environment Its Evaluation and Control. 2nd Ed. Dinardi, Salvatore. Fairfax, VA: American Industrial Hygiene Association, 2003.
6. Australian and New Zealand master work health and safety guide by Cormack E. Dunn ISBN: 9781925397130 Publication Date: 3rd ed. 2018 Print only. Copies in High Use Collection JOO & BUN.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	2	1	1	1	1	1	2	2	2	2
CO2	3	2	1	-	-	2	1	1	1	1	1	2	2	2	2
CO3	3	2	1	-	-	2	1	1	1	1	1	2	2	2	2
CO4	3	2	1	-	-	2	1	1	1	1	1	2	2	2	2
CO5	3	2	1	-	-	2	1	1	1	1	1	2	2	2	2
Avg.	**3**	**2**	**1**	**-**	**-**	**2**	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**2**	**2**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3073 FIRE ENGINEERING AND PROTECTION

L	T	P	C
3	**0**	**0**	**3**

COURSE OBJECTIVES

1. To anticipate, identify and evaluate hazardous conditions and practices
2. To develop hazard control designs, methods, procedures, and programs.
3. To illustrate the basic concepts and techniques of modern reliability engineering tools
4. To provide the students an illustration of significance of the Fire Engineering profession in the protection life, property and environment.
5. To understand the importance of life safety in building fire and method of evacuation.

UNIT I PROPERTIES OF COMBUSTION 9

Introduction- temperature, heat, specific heat, flash point, fire point, ignition, combustion; Ignition- pilot ignition, spontaneous ignition, Types of combustion-rapid, spontaneous, explosion; Development of fire- incipient, smoldering, flame and heat stages; Diffusion flames-zones of combustion, smoldering combustion,; Premixed flames-burning velocity, limits of flammability, explosion and expansion ratios, deflagration and detonation, characteristics of premixed flame; Explosion- physical explosion, chemical explosion; Special kinds of combustion- Flash fire, Pool fire, Deep seated fire, Spillover, Boil over, Dust explosion, BLEVE, UVCE; Classification of fire based on material

UNIT II BEHAVIOUR OF BUILDING ELEMENTS UNDER ACTION OF FIRE 9

Product of combustion-flame, heat, smoke, fire gases; spread of fire in rooms and buildings; Effect of heat exposure to human body Smoke - constituents of smoke, quantity and rate of production of smoke, quality of smoke, smoke density, visibility in smoke, smoke movement in buildings, modeling of smoke movement; Smoke control in buildings natural and mechanical ventilation, pressurization; Design principles of smoke control using pressurization technique; Principles of smoke vent design. Toxicity of smoke- effect of harmful agents preventing escape and causing injury or death - CO, CO_2, HCN, SO_2, NH_3, Nitrogen oxide.

UNIT III OPERATION HANDLING AND MAINTENANCE OF FIRE SERVICE EQUIPMENTS AND ACCESSORIES 9

Introduction to fire fighting vehicles and appliances- Pumps, primers, crash tenders, rescue tenders, hose laying tenders, control vans, hydraulic platforms - Delivery Hose, Hose reel, Hose fittings- coupling, adapters, branches, branch holders, radial branches, collecting heads, stand pipe, monitors, hydrants;; Ladders- Uses and maintenance of small gear and miscellaneous equipments used during firefighting; Lamps and lighting sets; Ropes and Lines- Types-wire and rope lines used in fire service. Use and testing of lines, knots, Bends and hitches; General rope work.

UNIT IV HYDRAULIC SYSTEM 9

Fire stream-path, range; nozzles-types, calculation of discharge capacity, nozzle reaction; friction losses in pipes, fire hoses and fixtures, parallel and series connections; Flow in pipes and fire hoses, branching lines; water relay techniques; Estimation of fire protection water requirements, pump capacity and other parameters relating to fire hydraulics. Fire ground operations - preplanning, action on arrival and control, methods of rescue, methods of entry. Personnel safety. Control procedure and use of other safety equipment. Ventilation and salvage operations.

UNIT V FIRE SUPPRESSION & PROTECTION 9

Introduction, Definitions, Water as an extinguishing agent, Basic Components of a Fire Protection system, Classification of fire protection systems-Active & Passive: Active FPS Definitions, classifications- Water Based (Vs) Non water based & Fixed (Vs) Portable/Mobile, Types:- Fire Extinguishers, Fire hydrants, Sprinklers, standpipe systems, Fire detectors, water spray systems - definitions, types, operation, applications & limitations, selection, installation & maintenance as per relevant national and international standards(IS, OISD, NFPA etc)

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Analyse the basics of fire engineering.
2. Use the classification of combustion and its products during fire safety assessments.

3. Demonstrate the operation of fire service equipment's and practical fire fighting
4. Categorize the buildings and design the evacuation methods
5. Apply acquired knowledge on real life problems

TEXT BOOKS

1. Gupta, R.S., "Hand Book of Fire Technology" Orient Longman, Bombay 1977.
2. Barendra Mohan Sen, "Fire protection and prevention the essential handbook". UBS Publishers' Distributors Pvt. Ltd, 2009.

REFERENCES

1. Ron Hirst, "Underdowns Practical Fire Precautions", Gower Publishing Company Ltd., England, 1989
2. Jain V.K. "Fire safety in buildings" (2nd edn.). New Age International (P) Ltd., New Delhi.2010.
3. Barendra Mohan Sen, Fire protection and prevention the essential handbook", UBS publishers and Dist., New Delhi,2013
4. Jain V.K., "Fire Safety in Buildings", New Age International (P) Ltd., New Delhi, 1996
5. N F P A. Fire Protection Hand Book.20th Edition, 2008

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	1	-	-	1	1	-	-	-	-	-	1	-	-
CO2	-	1	-	-	1	2	-	-	-	1	-	-	3	-	-
CO3	2	-	-	-	-	1	-	1	1	-	-	-	-	-	3
CO4	2	1	2	-	1	1	-	-	-	-	-	-	-	1	-
CO5	1	-	2	-	-	-	-	-	-	-	-	1	-	-	-
Avg.	2	1	2		1	1	1	1	1	1	-	1	2	1	3

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3074 **SAFETY IN CONSTRUCTION, ERECTION AND MAINTENANCE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. To examine the relationship between human factors and construction accident causes
2. To apply understanding of construction regulations and quality assurance in site management
3. To use understanding of prevention methods to control construction hazards.
4. Analyze and apply safety procedures for erection activities such as lifting, working at height, alignment, and fastening.
5. Analyze and apply safety practices in equipment maintenance using real accident cases.

UNIT I INTRODUCTION 9

Introduction to construction industry and safety issues in construction-Human factors in construction safety management- Roles of various groups and stake-holders in ensuring safety in construction industry -Framing of contract conditions on safety and related matters – Relevance of ergonomics in construction safety.

UNIT II SAFETY IN CONSTRUCTION OPERATIONS 9

Safety in various construction operations - Excavation and filling - Under- water works - Underpinning & Shoring - Ladders & Scaffolds - Tunnelling - Blasting - Dismantling - Confined space Temporary Structures. noise standards and limit values; noise instrumentation and monitoring procedure. Noise indices. Effects of air pollution in Industry, air pollution episodes; Emission factors inventory and predictive equations. Familiarization with relevant Indian Standards and the National Building Code provisions on construction safety

UNIT III CONSTRUCTION MACHINERY 9

Safety in material handling and equipment's-Safety in storage & stacking of construction materials. Safety in the use of construction equipment/vehicles - excavators, graders and dozers - cranes - hoists & lifts - other lifting gears˜ wire ropes - chain-pulley blocks - mixers - conveyors- pneumatic and hydraulic tools in construction. Safety in temporary power supply and fire safety at construction site.

UNIT IV SAFETY IN ERECTION 9

Erection: definition, types, and causes of erection-related hazards-Effects of erection on safety, reliability, and service life of components-Erection in industrial systems: pipelines, valves, pumps, turbines, structures, and process equipment-Monitoring, inspection, and maintenance during and after erection activities-safety measures in erection work: lifting operations, working at height, alignment, and fastening practices

UNIT V SAFETY IN MAINTENANCE 9

Need, scope, and types of maintenance-Hazards in maintenance work: mechanical, electrical, chemical, thermal, and ergonomic hazards-Safety in equipment maintenance: pumps, compressors, boilers, pressure vessels, turbines, and rotating machinery- Case studies of maintenance-related accidents and preventive measures.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Visualize the safety issues at different stages of construction activity.
2. Understand the safety requirements in various construction operations and develop guidelines to ensure safety at construction site.
3. Understand the safety requirements in material handling and Equipments and develop guidelines to ensure safety at construction site.

4. Analyse and apply safety procedures for erection activities such as lifting, working at height, alignment, and fastening.
5. Analyse and apply safety measures for maintenance activities using accident case studies.

TEXT BOOKS

1. Hsudon,R., Construction hazard and Safety Handbook, ButterWorth's,1985.
2. Raymond Elliot Levitt, Nancy Morse Samelson, "Construction Safety Management, McGraw Hill, London,1987.
3. Raghuwanshi & Shukla – Industrial Safety Engineering, includes hazards during erection, working at height, and equipment installation Simple and syllabus-oriented.

REFERENCES

1. Jnathea D.Sime, "Safety in the Build Environment", London,1988.
2. Davies,V. J., and Tomasin,K.(1996). Construction safety hand book. Thomas Telford Publishing, London.
3. Ratay,R.T.(1996). Handbook of temporary structures in construction (2ndedn.). McGrawHill, London.
4. K. U. Mistry – Industrial Safety and Health

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	3	2	2	3	-	3	-	2	-	1	-	2	2
CO2	1	2	3	1	-	3	-	-	1	3	1	1	-	1	3
CO3	-	2	3	-	2	3	-	1	-	-	-	-	1	-	-
CO4	-	1	3	2	-	3	2	-	1	1	-	2	2	-	1
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Avg.	**2**	**2**	**3**	**2**	**2**	**3**	**2**	**2**	**1**	**3**	**1**	**1**	**2**	**2**	**3**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24ME3075 TRANSPORTATION SYSTEMS AND SAFETY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. Use strategies to optimize spending in relation to public accounts.
2. Examine the relationship between safety objectives and harm reduction.
3. Apply health and safety policies in stakeholder interactions to enhance visibility.
4. Examine gaps in the objectives with respect to workplace hazards and compliance.
5. Implement systems to track performance and improvements.

UNIT I RAILWAY ENGINEERING 9

Introduction of Railway Engineering: Permanent way. Curves, super-elevation, negative superelevation, transition curve, grade compensation on curves. Railway operation ð control – points and crossings turn-out. Signalling and interlocking. Centralized traffic control. Railway accidents & safety. Rapid transit railways - types, merits & demerits.

UNIT II HIGHWAY ENGINEERING 9

Introduction of Highway Engineering: Classification of highways and urban road patterns. Typical cross section of roads. Factors controlling the alignment of roads. Basic geometric design - stopping and overtaking sight distances.

UNIT III TRAFFIC ENGINEERING 9

Introduction of Traffic Engineering: Traffic characteristics. Various traffic studies and their applications. Traffic signals. Carriage-way markings. Traffic islands. Highway intersections. Principles of highway lighting. Road Accidents - prevention, investigation and reduction

UNIT IV HARBOUR AND DOCK ENGINEERING 9

Introduction of Harbour& Dock Engineering: Water transportation, classification of harbours, accessibility and size, ports, Indian ports. Layout of ports, breakwater, facilities (in brief) for docking, repair, approach, loading and unloading, storing and guiding.

UNIT V AIR TRANSPORTATION ENGINEERING 9

Classification of air transportation, Types of air craft engines – Propellants-feeding systems – Ignition and combustion – Theory of rocket propulsion -Applications –Air way accidents & safety

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Apply the knowledge of railway track components, materials and fixtures and fastenings.
2. Solve problems of railway track geometrics, train resistance, points and crossings, Signalling and control system.
3. Apply road safety regulations and elements to reduce traffic accidents.
4. Implement preventive strategies based on highway safety elements and accident analysis.
5. Apply harbour operations principles in transport and trade management.

TEXT BOOKS

1. John Khisty C, Kent Lall B, "Transportation Engineering – An Introduction, 3rd Edition, Prentice Hall of India, New Delhi, 2002
2. B.S.Dhillon, Transportation systems, reliability and safety" CRC Press,

REFERENCES

1. Chandra, S. &Agarwal, M. M. “Railway Engineering”. Oxford University Press, New Delhi,2007
2. Khanna, S. K. and Justo, C. E. G., “Highway Engineering” (9th ed). Nem Chand & Brothers, NewDelhi,2001.
3. Geetham Tiwari& Dinesh Mohan, “Transport Planning & Traffic safety”
4. Srinivasan, R., “Harbour, Dock and Tunnel Engineering”. Charotar Publishing House Pvt. Ltd, Anand,2013.
5. Kadiyali, L. R., “Traffic Engineering and Transport Planning”, Khanna Publishers, New Delhi,2004

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	1	-	-	1	1	-	-	-	-	-	1	-	-
CO2	-	1	-	-	1	2	-	-	-	1	-	-	3	-	-
CO3	2	-	-	-	-	1	-	1	1	-	-	-	-	-	3
CO4	2	1	2	-	1	1	-	-	-	-	-	-	-	1	-
CO5	1	-	2	-	-	-	-	-	-	-	-	1	-	-	-
Avg.	2	1	2	-	1	1	1	1	1	1	-	1	2	1	3

“1” - low, “2” - medium, “3” - high, “-” - no correlation

Note: The average value of this course to be used for program articulation matrix

24ME3076 SAFETY IN ENGINEERING INDUSTRY

L	T	P	C
3	**0**	**0**	**3**

COURSE OBJECTIVES

1. To use the safety rules and regulations, standards and codes applicable for engineering industry.
2. To analyse the operation safeguard of machines used in industries.
3. To examine risks involved in explosive welding techniques.
4. To use understanding of process working principles and safety risks to promote safe manufacturing practices.
5. To develop the knowledge related to health and welfare measures in engineering Industry

UNIT I INTRODUCTION 9

General safety rules, principles, maintenance, Inspections of turning machines, boring machines, milling machine, planning machine and grinding machines, CNC machines, Wood working machinery, types, safety principles, electrical guards, work area, material handling, inspection, standards and codes- saws, types, hazard.

UNIT II MACHINERY SAFEGUARD 9

Hydraulic Jack, Hydraulic Cutter, Hydraulic Expander. Air Lifting Bags, Electric Power Tools:

- Electric Cutter, Electric Saw, Chain Saw etc. Small Gears: - Their types, Applications and working principal Ladders: Constructional features, their types, Material and applications Ropes: - Their types, material and applications.

UNIT III SAFETY IN WELDING AND HEAT TREATMENT 9

Gas welding and oxygen cutting, resistance welding, arc welding and cutting, common hazards, personal protective equipment, training, safety precautions in brazing, soldering and metalizing – explosive welding, selection, care and maintenance of the associated equipment and instruments – safety in generation, distribution and handling of industrial gases-colour coding – flashback arrestor.

UNIT IV MOULDING AND FORMING INDUSTRIES 9

Cold working, power presses, point of operation safe guarding, auxiliary mechanisms, feeding and cutting mechanism, hand or foot- operated presses, power press electric controls, power press set up and die removal, inspection and maintenance-metal sheers-press brakes. Hot working safety in forging, hot rolling mill operation, safe guards in hot rolling mills – hot bending of pipes, hazards and control measures. Safety in gas furnace operation, cupola, crucibles, ovens, foundry health hazards, work environment, material handling in foundries, Foundry production cleaning and finishing foundry processes.

UNIT V SAFETY IN FINISHING, INSPECTION AND TESTING 9

Heat treatment operations, electro plating, paint shops, sand and shot blasting, safety in inspection and testing, dynamic balancing, hydro testing, valves, boiler drums and headers, pressure vessels, air leak test, steam testing, safety in radiography, personal monitoring devices, radiation hazards, engineering and administrative controls, Indian Boilers Regulation.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Outline the safety rules, standards and codes in various mechanical engineering equipment's.
2. Apply correct selection of machine guarding systems for lathe, drilling, boring and milling machines.
3. Impart knowledge about safe procedures for welding, gas cutting, storage and handling of heat treatment processes.
4. Examine safety measures for cold forming and hot working of metals.
5. Apply the safety and welfare measures to be taken during finishing, Inspection and testing of various Mechanical processes.

TEXT BOOKS

1. John V. Grimaldi and Rollin H. Simonds, “Safety Management”, All India Travelers Book seller, New Delhi,1989
2. N.V. Krishnan “Safety in Industry” Jaico Publisher House,1996.
3. “Occupational safety Manual” BHEL, Trichy, 1988.
4. John V. Grimaldi and Rollin H. Simonds, “Safety Management”, Richard D Irwin, 1994.
5. Krishnan N.V. “Safety Management in Industry” Jaico Publishing House, Bombay, 1997.

REFERENCES

1. Accident Prevention Manual for Industrial Operations: National Safety Council, Chicago,1974
2. NC Balchin, “Health and Safety in Welding and Allied process”, Woodb head Publishing; 5th edition, 2002.
3. Indian Boiler acts and Regulations, Government of India
4. Philip Hagan “Accident Prevention Manual for Business and Industry”, N.S.C. Chicago, 13th edition, 2009
5. “The Indian boilers

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	-	-	1	1	1	2	1	1	2	1	1	-
CO2	2	2	2	-	-	1	1	1	2	1	1	2	1	1	-
CO3	2	2	2	-	-	1	1	1	2	1	1	2	1	1	-
CO4	2	2	2	-	-	1	1	1	2	1	1	2	1	1	-
CO5	2	2	2	-	-	1	1	1	2	1	1	2	1	1	-
Avg.	**2**	**2**	**2**	**-**	**-**	**1**	**1**	**1**	**2**	**1**	**1**	**2**	**1**	**1**	**-**

“1” - low, “2” - medium, “3” - high, “-” - no correlation

Note: The average value of this course to be used for program articulation matrix

24ME3077 SAFETY IN PETROLEUM AND PETROCHEMICAL INDUSTRIES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. To analyse the processes employed in petroleum refineries, petrochemical industries and with respect to fire risks.
2. To examine the various processes employed in petroleum refining and petrochemical industries
3. To design the fire protection facilities in oil refineries, depots and terminals

4. To demonstrate and ability to recognise the hazard involved in on shore and off shore drilling
5. To analyse the oil and gas rules and guidelines in India.

UNIT I INTRODUCTION 9

Simplified flow diagrams of a typical refinery– distillation unit, catalytic cracker, reformer, treating unit (hydro forming, gas purification, Sulphur recovery, lubricating oil unit) Simplified flow diagrams of Petrochemical Industry–steam cracking, butadiene extraction, ethane recovery, butyl rubber polymerization.

UNIT II POTENTIAL PETROLEUM HAZARDS 9

Potential fire hazards in petroleum and petrochemical industries (ignition by local sources, spark, flame, hot surface, ignition of oil mists and fumes.). Storage tank farms of petroleum and petrochemical industries–Identification of Hazards, Type of Tanks, Design, Layout, Fire prevention measures including lightning protection. Fire protection arrangement sin large tank farms. Design concepts of various fixed fire protection systems like Foam- Water Systems, Halogen & DCP systems. Lock out procedures. Salient features of codes / standards: NFPA, API, OISD and SHELL.

UNIT III FIRE PROTECTION FACILITIES IN OIL REFINERIES, DEPOTS &TERMINALS 9

Fire protection facilities in Oil Refineries, Depots &Terminals- Transportation of petroleum and petrochemical products (safety considerations, statutory considerations). Design and Construction requirements for cross country hydrocarbon pipelines. Liquefied Petroleum Gas (LPG)Bottling Plant Operations. Design Philosophies. Operating Practices-Safety and Fire Protection in bottling plants. Internal Safety Audits in (Procedures and Checklist) Transportation of Bulk Petroleum Products. Storage and Handling of Bulk Liquefied Petroleum Gas.

UNIT IV ON- SHORE AND OFF- SHORE DRILLING 9

On- Shore and Off- shore drilling. Classification of wells. Drilling method. Rotary drilling. Drilling equipment. Ground and off shore structures for drilling. Off shore platforms and drilling vessels. Drilling mud–functions, classification and properties. Blow-off, well kicks, Blowout preventer. Shallow gas. Directional drilling. Well killing procedure. Emergency shutdown, Methods of Rescue & Fire Fighting.

UNIT V DISASTER MANAGEMENT IN INDIA AND RELIEF 9

Petroleum and Oil & Gas rules and regulations in India, The Oil fields regulations and development Act, New Exploration Licensing Policy (NELP), Functions of directorate general of hydrocarbons, Petroleum and Natural Gas Regulatory Board.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Exposure about components of petroleum and petrochemical industries.
2. Implement the potential fire hazards in petroleum and petrochemical industries.
3. Examine the fire protection facilities in oil refineries.
4. Use drilling methods in petrochemical industries following standard procedures.
5. Apply Petroleum and Oil & Gas exploration rules and regulations in India during industry operations.

TEXT BOOKS

1. Frank P Lees: "Loss prevention in Process Industries–Vol.I, II &III", Butterworth–Heinem ann Publishing Company, UK.2004.
2. Alireza Bahadori, "Personnel Protection and Safety Equipment for the Oil and Gas Industries"1st Edition, Gulf Professional Publishing, 2015.
3. Dennis P. Nolan, "Application of HAZOP and What if Reviews to the Petroleum, Petrochemical and Chemical Process Industries", Noyes Publications, 1994
4. Dhanan joy Ghosh," Safety in Petroleum Industries, CRC Press,2021.

REFERENCES

1. Gopal Rao, M. and Sittig, M (Eds). "Dryden´s outlines of chemical technology for the 21st century". (Third edition). Affiliated East West Press, New Delhi,2010.
2. Sam Mannan (Editor). "Lee´s loss prevention in the process industries" (fourth edition). Butterworth-Heinemann Ltd., UK,2012.
3. Davorin Matanovic. Nedilika Gaurina- Medjimurec. And Katarina Simon. "Risk analysis for prevention of hazardous situations in petroleum and natural gas engineering". Engineering Science Reference, Hershey PA,2014.
4. Aven, T. and Vinnem, J.E. "Risk management with applications from the offshore petroleum industry". Springer-Verlag, U.K,2007.
5. John C. Reis, "Environmental Control in Petroleum Engineering", Gulf Publishing Company, 1996.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	-	1	1	-	-	1	1	3	2	1	2
CO2	3	2	1	1	-	1	1	-	-	1	1	3	2	1	2
CO3	3	2	1	1	-	1	1	-	-	1	1	3	2	1	2
CO4	3	2	1	1	-	1	1	-	-	1	1	3	2	1	2
CO5	3	2	1	1	-	1	1	-	-	1	1	3	2	1	2
Avg.	**3**	**2**	**1**	**1**	**-**	**1**	**1**	**-**	**-**	**1**	**1**	**3**	**2**	**1**	**2**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix

24ME3078 FIRE FIGHTING AND SAFETY EQUIPMENT

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. To describe the meaning and importance of human factors engineering
2. To relate human sensory, cognitive, and physical capabilities and limitations to the design of human-machine systems
3. To select and correctly use appropriate human-machine system analysis and design tools.
4. To apply sound human-machine system design principles to develop written and graphical design specifications
5. To recognize and construct proper recommendations to correct human factors deficiencies in human-machine systems in written and/or graphical form

UNIT I GENERAL PRINCIPLES OF FIRE PREVENTION AND PROTECTION MEASURES 9

Planning and Construction of the building: Site planning considering the nature of the plant, building, equipment and process from the stand point of safety and fire protection, where corrosive, poisonous, explosive and easily combustible materials are handled and processed. Type Of construction fire wall, barricades etc. Fire separation, fire steps, segregation, isolation.

UNIT II INTERNAL PLANNING AND COMBUSTION OF PLANTS AND BUILDINGS 9

Layout of hazardous pipe lines, vessels and equipment, planning of strategic points and selection of fire extinguishing device, Automatic, fire doors, fire, doors, wire glass windows, fire walls, parapeted to prevent spread of fire through roofs, vertical cut offs, Exits, guard & guarding, floor platforms, path roadways, stairs ventilation

UNIT III FIRE PROTECTION ARRANGEMENT: FIRE APPLIANCES 9

Fire warning system (Manual & Automatic) fixed fire-fighting installations: Foam system; Gas/vapor system; Dry powder system; Special safety protection equipment-Explosion detection, venting and suppression system, Inergen clean agent system and F.M. 200.

UNIT IV SAFETY EQUIPMENT 9

Different Extinguishing properties & application like water, foam, carbon die oxide, dry chemical powder, halogenated agent and halon alternatives. Lighting: lighting arrangement and minimum light require in domestic, commercial, industrial and public assembly occupancies etc. Emergency lighting system

UNIT V SAFETY AND FIRE PROTECTION ORGANIZATION 9

House-keeping and management; Plant fire brigade and fire fitting facilities, petrol, systems. Detailed analysis of fire case studies: especially those fires where large number of people have been involved. Interaction and relative value of the components of escape route design, especially smoke movement and control.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Explain and apply human factors engineering concepts in both evaluation of existing systems and design of new systems.
2. Specify designs that avoid occupation related injuries.
3. Define and apply the principles of work design, motion economy, and work environment design.
4. Identify the basic human sensory, cognitive, and physical capabilities and limitations with respect to human-machine system performance
5. Acknowledge the impact of workplace design and environment on productivity

TEXT BOOKS

1. General fire hazards and fire protection by J.J. Williams
2. Fire prevention Notes for Industrial premises by F.P.A.

REFERENCES

1. Fire prevention hand book by Kesteren fire Brigade
2. Fire prevention standard recommendations by Earnest Beam Ltd
3. Automation- A challenge to fire protection Engineers by Warre J. Baker
4. Fire Protection- Technical information and Useful general knowledge by Mather and Platt
5. Hand book of fire protection by N.F.P.A. 8. Fire protection in factory, buildings by H, N, S, O.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	2	-	-	-	-	-	-	-	2	-	-	-	-
CO2	-	-	2	-	-	-	-	-	-	-	1	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO5	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Avg.	2	-	2	-	-	-	-	1	-	-	2	-	-	-	-

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix

MANDATORY COURSES I

24MX3081 INTRODUCTION TO WOMEN AND GENDER STUDIES

L	T	P	C
3	0	0	0

COURSE OBJECTIVES

1 To understand what gender means and why it is important.
2 To learn about the problems and challenges faced by women.
3 To know how society, family, school, and media shape gender roles.
4 To become aware of gender inequality and discrimination.
5 To develop respect, fairness, and equality towards all genders.

UNIT I GROWTH OF WOMEN'S STUDIES / GENDER STUDIES 9

Objectives and scope of Women's Studies – Need for Women's Studies Introducing Women's Studies in Higher Education - Role of Women's Studies Centre – Women Studies Programme in India – UGC initiatives – Women's Studies in Tamil Nadu – Case Studies

UNIT II GENDER SOCIALIZATION 9

Stages – Agencies of socialization – Social Construction of Gender Sex and Gender – Gender Discrimination Gender Stereotyping – Gender Sensitivity - Gender Roles – Gender Perspective – Gender Analysis – Gender Auditing – Gender Budgeting Gender Equity – Gender Equality - Gender Mainstreaming – Role Play

UNIT III ISSUES RELATED TO FEMALE CHILDREN 9

Female feticide – Female infanticide – Child Marriage – Prostitution – Transgender and juvenile Girls HIV positive children – Differently abled Children – COVID19 Pandemic and girl child

UNIT IV WOMEN AND INSTITUTIONS OF SOCIAL SYSTEM 9

Family – types – Marriage – types of marriage – Multiple roles of women – Caste – Class-Culture Religion and Social system – Initiatives for minorities empowerment – Evaluation

UNIT V STATUS OF WOMEN 9

Status – Concept – Meaning – Definition – Types of status – Achieved and Ascribed status – factors and indicators of status of women-Status of women in Indian Society – Emerging trends in Women's Studies-Women Empowerment

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. To understand the need and significance of Gender Studies.
2. To gain knowledge of key concepts and theories related to gender.
3. To develop awareness of issues concerning female children.

4. To evaluate the role of social institutions in shaping and perpetuating gender discrimination.
5. To understand the contemporary status and challenges faced by women in the present scenario.

REFERENCES

1 L. Ayu Saraswati, Barbara L. Shaw, and Heather Rellihan 2020 “Introduction to Women's, Gender and Sexuality Studies” ISBN: 9780190084806

2 Melissa J. Gillis, Andrew T. Jacobs 2019 “Introduction to Women's and Gender Studies: An Interdisciplinary Approach”

3 Eliza Long, 2022 “Introduction to Gender Studies” Social Sciences, ISBN9781641726917, Larsen and Keller Education

4 Maithreyi Krishna Raj, 1986, Women Studies in India – Some Perspectives, Popular Prakasham, Bombay

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	1	1	1	3	3	-	3	3	2	2
CO2	-	-	-	-	-	1	1	1	3	3	-	3	3	3	2
CO3	-	-	-	-	-	1	1	1	3	3	-	3	3	3	2
CO4	-	-	-	-	-	1	1	1	3	3	-	3	2	2	3
CO5	-	-	-	-	-	1	1	1	3	3	-	3	2	2	3
Avg.	-	-	-	-	-	**1**	**1**	**1**	**3**	**3**	-	**3**	**3**	**3**	**3**

“1” - low, “2” - medium, “3” - high, “-” - no correlation

Note: The average value of this course to be used for program articulation matrix.

24MX3082 INDIAN KNOWLEDGE SYSTEMS

L	T	P	C
3	**0**	**0**	**0**

COURSE OBJECTIVES

1. The course introduces India’s traditional knowledge systems and shows their importance in today’s world.
2. It explains how knowledge was created and used in fields like philosophy, science, medicine, arts, agriculture, and architecture.
3. Students learn the basic principles of IKS, focusing on holistic thinking, sustainability, and harmony between humans, society, and nature.
4. The course compares classical texts and indigenous practices with modern scientific ideas to encourage critical understanding.
5. It highlights how IKS can help solve current issues such as environmental protection, health, community welfare, and sustainable development.

UNIT I INTRODUCTION TO IKS 9

Definition and characteristics of Indian Knowledge Systems - Historical evolution from ancient times to the 18th century CE - Impact of colonial education policies and the need for revisiting traditional Knowledge - Traditional educational institutions: Gurukuls, Pathshalas, Takshashila, and Nalanda - Local heritage sites and their relevance.

UNIT II INTRODUCTION TO ANCIENT INDIAN MATHEMATICS AND ASTRONOMY 9

Mathematics: Ancient numeral systems and mathematical concepts - Logic: Indian logic systems and epistemology - Overview of Indian astronomy; celestial coordinate systems and calendar systems - Astronomical Instruments (Yantras)- Application of Physics and Chemistry

UNIT III INTRODUCTION TO HEALTH AND MEDICINE 9

In-depth study of Ayurveda, its diagnostic methods, and therapeutic practices - Understanding the holistic approach to health encompassing physical, mental, and spiritual well-being - Application of Ayurveda principles in contemporary healthcare systems - Ayurvedic perspectives on health, including dietary regimes, disease management, elements of wellness—and their intersections with botany and medical science

UNIT IV INTRODUCTION TO ANCIENT GOVERNANCE AND PUBLIC ADMINISTRATION 9

Analysis of ancient Indian governance models and administrative structures - Insights from texts like Arthashastra on statecraft and economics - Relevance of traditional governance principles in modern administrative Practices - Concept of Kingship; duties and responsibilities of a monarch - Three-tier political system: Dharmadanda, Rajdanda, Nyāyadanda - Law & administration, crime suppression, defence systems, foreign policy - Concept of wealth, ownership, and distribution - Kautilya's "Saptanga" model (seven sources of income) - Taxation, savings, and expenditure in ancient Indian economy

UNIT V INTRODUCTION TO ANCIENT ARTS AND CULTURE 9

Study of traditional Indian art forms, including sculpture, dance, and music - Understanding the cultural significance and philosophical underpinnings of these art forms - Promotion of cultural heritage through education and practice - Temple architecture overview - Cave and monolithic architecture - Architectural styles: Chalukya, Pallava, Chola, Hoysala, Mauryan, Vijayanagara. Buddhist and Jain art & architectural heritage

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Understand what Indian Knowledge Systems are and how they developed.
2. Learn basic ideas of ancient Indian mathematics and astronomy.
3. Understand the principles of Ayurveda and holistic health.

4. Learn how ancient Indian governance and administration worked.
5. Understand traditional Indian art, architecture, and cultural heritage.

REFERENCES

1. Introduction to Indian Knowledge System: Concepts and Applications by B. Mahadevan.
2. Indian Knowledge System by Kapil Kapoor and Avadhesh Kumar Singh
3. Traditional Knowledge System in India by Amit Jha.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	-	-	-	1	-	-	2	2	-	-
CO2	3	3	2	2	-	-	-	-	1	-	-	2	3	-	-
CO3	2	2	1	-	-	-	-	-	1	-	-	3	2	2	-
CO4	2	3	2	1	-	-	-	-	2	-	-	2	-	-	-
CO5	1	2	1	-	-	-	-	-	1	-	-	2	2	2	-
Avg.	**3**	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**3**	**3**	**1**	**-**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24MX3083 PRODUCTION AND OPERATIONS MANAGEMENT FOR ENTREPRENEURS

L	T	P	C
3	**0**	**0**	**0**

COURSE OBJECTIVES

1. To know the basic concept and function of Production and Operation Management for entrepreneurship.
2. To understand the Production process and planning.
3. To understand the Production and Operations Management Control for business owners.
4. To understand the Production and Management process
5. To understand the process of Controlling Productions.

UNIT I INTRODUCTION TO PRODUCTION AND OPERATIONS MANGEMENT 9

Functions of Production Management - Relationship between production and other functions – Production management and operations management, Characteristics of modern production and operation management, organization of production function, recent trends in production /operations management - production as an organizational function, decision making in production Operations research

UNIT II PRODUCTION & OPERATION SYSTEMS 9

Production Systems- principles – Models - CAD and CAM- Automation in Production - Functions and significance- Capacity and Facility Planning: Importance of capacity planning- Capacity measurement – Capacity Requirement Planning (CRP) process for manufacturing and service industry

UNIT III PRODUCTION & OPERATIONS PLANNING 9

Facility Planning – Location of facilities – Location flexibility – Facility design process and techniques – Location break even analysis-Production Process Planning: Characteristic of production process systems – Steps for production process- Production Planning Control Functions – Planning phase- Action phase- Control phase - Aggregate production planning

UNIT IV PRODUCTION & OPERATIONS MANAGEMENT PROCESS 9

Process selection with PLC phases- Process simulation tools- Work Study – Significance – Methods, evolution of normal/ standard time – Job design and rating - Value Analysis - Plant Layout: meaning – characters –- Plant location techniques - Types- MRP and Layout Design - Optimisation and Theory of Constraints (TOC)– Critical Chain Project Management (CCPM)- REL (Relationship) Chart – Assembly line balancing- – Plant design optimisation -Forecasting methods.

UNIT V CONTROLING PRODUCTION & OPERATIONS MANAGEMENT 9

Material requirement planning (MRP)- Concept- Process and control - Inventory control systems and techniques – JIT and Lean manufacturing - Network techniques - Quality Management: Preventive Vs Breakdown maintenance for Quality – Techniques for measuring quality - Control Chart (X , R , p , np and C chart) - Cost of Quality, Continuous improvement (Kaizen) - Quality awards - Supply Chain Management - Total Quality Management - 6 Sigma approach and Zero Defect Manufacturing.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. To understand the basics and functions of Production and Operation Management for business owners.
2. To learn about the Production & Operation Systems.
3. To acquaint on the Production & Operations Planning Techniques followed by entrepreneurs in Industries.
4. To known about the Production & Operations Management Processes in organisations.
5. To comprehend the techniques of controlling, Production and Operations in industries.

REFERENCES

1. Mikell P. Groover, Automation, Production Systems, and Computer-Integrated Manufacturing, Pearson, 2007.

2. Amitabh Raturi, Production and Inventory Management, , 2008.
3. Adam Jr. Ebert, Production and Operations Management, PHI Publication, 1992.
4. Muhlemann, Okland and Lockyer, Production and Operation Management, Macmillan India,1992.
5. Chary S.N, Production and Operations Management, TMH Publications, 2010.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	3	-	-	-	-	2	2	-	-	3	2	2
CO2	3	2	2	3	-	-	-	-	2	1	-	-	3	3	2
CO3	2	3	2	3	-	-	-	-	2	2	-	-	2	3	2
CO4	2	2	2	3	-	-	-	-	2	1	-	-	2	2	3
CO5	3	3	3	3	-	-	-	-	2	2	-	-	3	3	3
Avg.	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**3**	**2**	**-**	**-**	**3**	**3**	**3**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24MX3084 DISASTER RISK REDUCTION AND MANAGEMENT

L	T	P	C
3	**0**	**0**	**0**

COURSE OBJECTIVES

1. To impart knowledge on concepts related to disaster, disaster risk reduction, disaster management
2. To acquaint with the skills for planning and organizing disaster response
3. To understand the types, causes, and impacts of natural and man-made disasters.
4. To develop the skills to plan, respond to, and manage disaster situations effectively.
5. To learn strategies and methods for disaster prevention, preparedness, and mitigation.

UNIT I HAZRADS, VULNERABILITY AND DISASTER RISKS 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced, Climate change induced –Earthquake, Landslide, Flood, Drought, Fire etc – Technological disasters- Structural collapse, Industrial accidents, oil spills -Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.- Disaster vulnerability profile of India and Tamil Nadu - Global trends in disasters: urban disasters, pandemics, Complex emergencies, - -, Inter relations between Disasters and Sustainable development Goals

UNIT I DISASTER RISK REDUCTION (DRR) 9

Sendai Framework for Disaster Risk Reduction, Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Early Warning System – Advisories from Appropriate Agencies. - Relevance of indigenous Knowledge, appropriate technology and Local resources.

UNIT III DISASTER MANAGEMENT 9

Components of Disaster Management – Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction- Disaster Risk Management and post disaster management – Compensation and Insurance- Disaster Management Act (2005) and Policy - Other related policies, plans, programmers and legislation - Institutional Processes and Framework at State and Central Level- (NDMA –SDMA-DDMA-NRDF- Civic Volunteers)

UNIT IV TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT 9

Early warning systems -Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment. - Elements of Climate Resilient Development –Standard operation Procedure for disaster response – Financial planning for disaster Management

UNIT V DISASTER MANAGEMENT: CASE STUDIES 9

Discussion on selected case studies to analyse the potential impacts and actions in the contest of disasters-Landslide Hazard Zonation: Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.- Field work-Mock drill.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. To impart knowledge on the concepts of Disaster, Vulnerability and Disaster Risk reduction (DRR)
2. To enhance understanding on Hazards, Vulnerability and Disaster Risk Assessment prevention and risk reduction
3. To develop disaster response skills by adopting relevant tools and technology

4. Enhance awareness of institutional processes for Disaster response in the country
5. Develop rudimentary ability to respond to their surroundings with potential Disaster response in areas where they live, with due sensitivity

TEXT BOOKS

1. Taimpo (2016), Disaster Management and Preparedness, CRC Publications
2. Singh R (2017), Disaster Management Guidelines for earthquakes, Landslides, Avalanches and tsunami, Horizon Press Publications
3. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN- 13: 978-9380386423
4. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361]

REFERENCES

1. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005.
2. Government of India, National Disaster Management Policy, 2009.
3. Shaw R (2016), Community based Disaster risk reduction, Oxford University Press

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	-	-	1	1	2	2	-	-	2	-	1
CO2	3	3	3	3	-	-	1	1	2	1	-	-	2	-	1
CO3	3	3	3	3	-	-	1	1	2	2	-	-	2	-	1
CO4	3	3	2	3	-	-	1	1	2	1	-	-	2	-	1
CO5	3	3	2	3	-	-	1	1	2	2	-	-	3	-	1
Avg.	**3**	**3**	**3**	**3**	**-**	**-**	**2**	**2**	**3**	**2**	**-**	**-**	**3**	**-**	**2**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24MX3085 WELL-BEING WITH TRADITIONAL PRACTICES-YOGA, AYURVEDA AND SIDDHA

L	T	P	C
3	**0**	**0**	**0**

COURSE OBJECTIVES

1. To enjoy life happily with fun filled new style activities that help to maintain health also
2. To adapt a few lifestyle changes that will prevent many health disorders
3. To be cool and handbill every emotion very smoothly in every walk of life
4. To learn to eat cost effective but healthy foods that are rich in essential nutrients

5. To develop immunity naturally that will improve resistance against many health disorders

UNIT I HEALTH AND ITS IMPORTANCE 9

Health: Definition - Importance of maintaining health - More importance on prevention than treatment -Ten types of health one has to maintain - Physical health - Mental health - Social health - Financial health - Emotional health - Spiritual health - Intellectual health - Relationship health - Environmental health - Occupational/Professional heath.

Present health status - The life expectancy-present status - mortality rate - dreadful diseases - non-communicable diseases (NCDs) the leading cause of death - 60% - heart disease – cancer – diabetes - chronic pulmonary diseases - risk factors – tobacco – alcohol - unhealthy diet - lack of physical activities.

Types of diseases and disorders - Lifestyle disorders – Obesity – Diabetes - Cardiovascular diseases – Cancer – Strokes – COPD - Arthritis - Mental health issues.

Causes of the above diseases / disorders - Importance of prevention of illness - Takes care of health - Improves quality of life - Reduces absenteeism - Increase satisfaction - Saves time

Simple lifestyle modifications to maintain health - Healthy Eating habits (Balanced diet according to age) Physical Activities (Stretching exercise, aerobics, resisting exercise) - Maintaining BMI-Importance and actions to be taken

UNIT II DIET 9

Role of diet in maintaining health - energy one needs to keep active throughout the day - nutrients one needs for growth and repair - helps one to stay strong and healthy - helps to prevent diet-related illness, such as some cancers - keeps active and - helps one to maintain a healthy weight - helps to reduce risk of developing lifestyle disorders like diabetes – arthritis – hypertension – PCOD – infertility – ADHD – sleeplessness -helps to reduce the risk of heart diseases - keeps the teeth and bones strong.

Balanced Diet and its 7 Components - Carbohydrates – Proteins – Fats – Vitamins – Minerals - Fibre and Water.

Food additives and their merits & demerits - Effects of food additives - Types of food additives - Food additives and processed foods - Food additives and their reactions

Definition of BMI and maintaining it with diet -Importance - Consequences of not maintaining BMI - different steps to maintain optimal BM

Common cooking mistakes- Different cooking methods, merits and demerits of each method

UNIT III ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH 9

AYUSH systems and their role in maintaining health - preventive aspect of AYUSH - AYUSH as a soft therapy.

Secrets of traditional healthy living - Traditional Diet and Nutrition - Regimen of Personal and Social Hygiene - Daily routine (Dinacharya) - Seasonal regimens (Ritucharya) - basic sanitation and healthy living environment - Sadvritta (good conduct) - for conducive social life.

Principles of Siddha & Ayurveda systems - Macrocosm and Microcosm theory - Pancheekarana Theory / (Five Element Theory) 96 fundamental Principles - Uyir Thathukkal (Tri-Dosha Theory) - Udal Thathukkal

Prevention of illness with our traditional system of medicine

Primary Prevention - To decrease the number of new cases of a disorder or illness - Health promotion/education, and - Specific protective measures - Secondary Prevention - To lower the rate of established cases of a disorder or illness in the population (prevalence) - Tertiary Prevention - To decrease the amount of disability associated with an existing disorder.

UNIT IV MENTAL WELLNESS 9

Emotional health - Definition and types - Three key elements: the subjective experience - the physiological response - the behavioral response - Importance of maintaining emotional health - Role of emotions in daily life -Short term and long term effects of emotional disturbances - Leading a healthy life with emotions - Practices for emotional health - Recognize how thoughts influence emotions - Cultivate positive thoughts - Practice self-compassion - Expressing a full range of emotions.

Stress management - Stress definition - Stress in daily life - How stress affects one's life - Identifying the cause of stress - Symptoms of stress - Managing stress (habits, tools, training, professional help) - Complications of stress mismanagement.

Sleep - Sleep and its importance for mental wellness - Sleep and digestion.

Immunity - Types and importance - Ways to develop immunity

UNIT V YOGA 9

Definition and importance of yoga - Types of yoga - How to Choose the Right Kind for individuals according to their age - The Eight Limbs of Yoga - Simple yogasanas for cure and prevention of health disorders - What yoga can bring to our life.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Learn the importance of different components of health
2. Gain confidence to lead a healthy life

3. Learn new techniques to prevent lifestyle health disorders
4. Understand the importance of diet and workouts in maintaining health
5. Understand the importance of yoga and physical fitness.

TEXT BOOKS

1. Nutrition and Dietetics - Ashley Martin, Published by White Word Publications, New York, NY 10001, USA
2. Yoga for Beginners_ 35 Simple Yoga Poses to Calm Your Mind and Strengthen Your Body, by Cory Martin, Copyright © 2015 by Althea Press, Berkeley, California

REFERENCES

1. What we know about emotional intelligence How It Affects Learning, Work, Relationships, and Our Mental Health, by Moshe Zeidner, Gerald Matthews, and Richard D. Roberts
2. A Bradford Book, The MIT Press, Cambridge, Massachusetts, London, England The Mindful Self-Compassion Workbook, Kristin Neff, Ph.D Christopher Germer, Ph.D, Published by The Guilford Press A Division of Guilford Publications, Inc.370 Seventh Avenue, Suite 1200, New York, NY 10001

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	-	-	-	-	1	-	1	-	-	-
CO2	3	2	2	-	-	-	-	-	-	1	-	1	-	-	-
CO3	2	1	2	-	-	-	-	-	-	2	1	1	-	-	-
CO4	1	-	2	-	-	-	-	-	-	2	1	2	-	-	-
CO5	2	1	1	-	-	-	-	-	-	1	1	2	-	-	-
Avg.	**3**	**2**	**3**	-	-	-	-	-	-	**2**	**1**	**2**	-	-	-

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

MANDATORY COURSES II

24MX3086 **ENVIRONMENTAL SCIENCES AND SUSTAINABILITY**

L	T	P	C
3	0	0	0

COURSE OBJECTIVES

1. To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
2. To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
3. To facilitate the understanding of global and Indian scenario of renewable and non-renewable resources, causes of their degradation and measures to preserve them.
4. To familiarize the concept of sustainable development goals and appreciate the interdependence of economic and social aspects of sustainability, recognize and analyze climate changes, concept of carbon credit and the challenges of environmental management.
5. To inculcate and embrace sustainability practices and develop a broader understanding on green materials, energy cycles and analyze the role of sustainable urbanization.

UNIT I ENVIRONMENT AND BIODIVERSITY 9

Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ.

UNIT II ENVIRONMENTAL POLLUTION 9

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts.

UNIT III RENEWABLE SOURCES OF ENERGY 9

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

UNIT IV SUSTAINABILITY AND MANAGEMENT 9

Development, GDP, Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols Sustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.

UNIT V SUSTAINABILITY PRACTICES 9

Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cycles carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio economical and technological change.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

1. To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.
2. To identify the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society.
3. To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.
4. To recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development.
5. To demonstrate the knowledge of sustainability practices and identify green materials, energy cycles and the role of sustainable urbanization.

TEXT BOOKS

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers ,2018.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
3. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.

REFERENCES

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38 . edition 2010.

2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition, 2015.
5. ErachBharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	2	3	-	-	-	-	2	-	-	-
CO2	3	2	-	-	-	3	3	-	-	-	-	2	-	-	-
CO3	3	-	1	-	-	2	2	-	-	-	-	2	-	-	-
CO4	3	2	1	1	-	2	2	-	-	-	-	2	-	-	-
CO5	3	2	1	-	-	2	2	-	-	-	-	1	-	-	-
Avg.	3	2	1	1	-	3	3	-	-	-	-	3	-	-	-

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24MX3087 HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA

L	T	P	C
3	0	0	0

COURSE OBJECTIVES

1. To understand the basic concepts of history and science in India.
2. To learn about important historians of science and technology.
3. To study science and technology in ancient India.
4. To study science and technology in medieval India.
5. To learn about science and technology in colonial and modern India.

UNIT I CONCEPTS AND PERSPECTIVES 9

Meaning of History Objectivity, Determinism, Relativism, Causation, Generalization in History; Moral judgment in history Extent of subjectivity, contrast with physical sciences, interpretation and speculation, causation verses evidence, concept of historical inevitability, Historical Positivism. Science and Technology-Meaning, Scope and Importance, Interaction of science, technology & society, Sources of history on science and technology in India.

UNIT II HISTORIOGRAPHY OF SCIENCE AND TECHNOLOGY IN INDIA 9

Introduction to the works of D.D. Kosambi, Dharmpal, Debiprasad Chattopadhyay, Rehman, S. Irfan Habib, Deepak Kumar, Dhruv Raina, and others.

UNIT: III SCIENCE AND TECHNOLOGY IN ANCIENT INDIA 9

Technology in pre-historic period Beginning of agriculture and its impact on technology Science and Technology during Vedic and Later Vedic times Science and technology from 1st century AD to C-1200.

UNIT IV SCIENCE AND TECHNOLOGY IN MEDIEVAL INDIA 9

Legacy of technology in Medieval India, Interactions with Arabs Development in medical knowledge, interaction between Unani and Ayurveda and alchemy Astronomy and Mathematics: interaction with Arabic Sciences Science and Technology on the eve of British conquest

UNIT V SCIENCE AND TECHNOLOGY IN COLONIAL INDIA AND POST-INDEPENDENT INDIA 9

Science and the Empire Indian response to Western Science Growth of techno-scientific institutions- Science, Technology and Development discourse Shaping of the Science and Technology Policy Developments in the field of Science and Technology Science and technology in globalizing India Social implications of new technologies like the Information Technology and Biotechnology

TOTAL: 45 PERIODSCOURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Understand the relationship between history, science, and society in India.
2. Recognize contributions of major historians of science.
3. Explain scientific and technological developments in ancient India.
4. Describe science and technology during medieval India.
5. Understand modern science and technology and their social impact in India.

REFERENCES

1. History of Science and Technology in India by Dr. Binod Bihari Satpathy
2. R. Parthasarathy, Paths of Innovators In Science, Engineering and Technology, EastWest Books (Madras) Pvt. Ltd, 2000.
3. Glimpses of India‘s Statistical Heritage, Edited by: J.K. Ghosh, S.K. Mitra, K.R. Parthasarathy, Wiley Eastern Limited, 1992.
4. Jagjit Singh, Some Eminent Indian Scientists, Publications Division, Ministry of Information and Broadcasting, Government of India, 1991.
5. B.C. Berndt and R.A. Rankin, Ramanujan: Essays and Surveys, Hindustan Book Agency, 2003.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	3	2	2	-	2	1	3	-	-	-
CO2	-	-	-	-	-	3	2	2	-	2	1	3	-	-	-
CO3	-	-	-	-	-	3	2	2	-	2	1	3	-	-	-
CO4	-	-	-	-	-	3	2	2	-	2	1	3	-	-	-
CO5	-	-	-	-	-	3	2	3	-	2	1	3	-	-	-
Avg.	-	-	-	-	-	**3**	**2**	**3**	-	**2**	**1**	**3**	-	-	-

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24MX3088 POLITICAL AND ECONOMIC THOUGHT FOR A HUMANE SOCIETY

L	T	P	C
3	**0**	**0**	**0**

COURSE OBJECTIVES

1. To introduce students to human needs, desires, and the evolution of political and economic systems aimed at fulfilling them.
2. To examine and critically analyse major political and economic systems, including capitalism, communism, fascism, welfare state, and liberal democracy.
3. To explore Gandhian thought and Indian civilisational perspectives as models for a humane and just society.
4. To understand the role of technology, education, and social transformation in shaping human welfare and societal progress.
5. To enable students to evaluate and propose alternative political-economic frameworks that promote equity, sustainability, and human well-being.

UNIT I FOUNDATIONS OF A HUMANE SOCIETY 9

Considerations for a humane society – Holistic thought – Human being's desires – Harmony in the self – Harmony in human relationships – Harmony in society and nature – Introduction to societal systems.

UNIT II CAPITALISM, FASCISM & TOTALITARIAN SYSTEMS 9

Capitalism: Free Markets, Demand–Supply, Perfect Competition, Laissez-Faire, Monopolies, Imperialism – Liberal Democracy. Fascism & Totalitarianism – World War I & II – Cold War.

UNIT III COMMUNISM & WELFARE STATE 9

Communism: Mode of production – Theory of labour – Surplus value – Class struggle – Dialectical materialism – Historical materialism – Russian and Chinese models.

Welfare State: relation with human desires – Empowered human beings – Satisfaction and well-being.

UNIT IV GANDHIAN THOUGHT & INDIAN CIVILISATION 9

Gandhian thought: Swaraj – Decentralized economy and polity – Community life – Control over one's life – Relationship with nature. Essential elements of Indian civilisation – Cultural, ethical and social foundations.

UNIT V TECHNOLOGY, EDUCATION & FUTURE DIRECTIONS 9

Technology as a driver of society – Technology and human relationships – Role of education in shaping society – Social transformation – Future directions for a humane society – Conclusion.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Understand the relationship between human needs, desires, and the evolution of political and economic systems.
2. Analyse and compare different political-economic systems, including capitalism, communism, fascism, welfare state, and liberal democracy, in terms of human welfare and social justice.
3. Evaluate Gandhian thought and Indian civilisational perspectives as approaches to building a humane and equitable society.
4. Assess the role of technology, education, and social transformation in shaping society and promoting human well-being.
5. Apply political-economic theories and perspectives to contemporary issues and propose pathways for a sustainable and humane society.

REFERENCES

1. M.K. Gandhi, Hind Swaraj, Navajivan Publishing House
2. Adam Smith, The Wealth of Nations, Oxford University Press
3. Karl Marx, Selected Writings, Oxford University Press
4. E.F. Schumacher, Small Is Beautiful: Economics as if People Mattered, Harper & Row

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	-	-	-	-	-	-	-	-	1	-	-	-
CO2	3	3	2	2	-	-	-	-	1	-	-	2	-	-	-
CO3	3	2	2	1	-	-	-	-	2	1	-	2	-	-	-
CO4	2	2	2	3	2	-	-	-	2	1	1	2	-	-	-
CO5	3	3	2	2	2	-	-	-	3	2	1	2	-	-	-
Avg.	3	3	3	2	1	-	-	-	2	1	1	3	-	-	-

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24MX3089 STATE, NATION BUILDING AND POLITICS IN INDIA

L	T	P	C
3	**0**	**0**	**0**

COURSE OBJECTIVES

1. To provide an understanding of the State, its functions, and the working of its main organs.
2. To explain the primacy of politics, political processes, and the concept of sovereignty, including its changing nature in a globalized world.
3. To acquaint students with the major developments and legacies of the Indian national movement and constitutional evolution.
4. To analyse the rationale for adopting a Parliamentary–Federal system in India and understand the broad philosophy underlying the Indian Constitution.
5. To examine the challenges of national integration and nation-building, and to encourage students to envision future pathways for a more inclusive and better India.

UNIT I STATE, SOVEREIGNTY AND POLITICAL SYSTEM 9

Understanding the Need and Role of the State – Meaning and Scope of Politics – Development of the Nation-State – Concept of Sovereignty – Types and Features of Sovereignty – Sovereignty in a Globalized World – Organs of the State: Executive, Legislature, Judiciary – Functions of Each Organ – Separation of Powers – Forms of Government: Unitary and Federal; Presidential and Parliamentary Systems.

UNIT II IDEA OF INDIA AND THE NATIONAL MOVEMENT 9

The Idea of India – 1857 and the National Awakening – Emergence of National Consciousness – Formation of the Indian National Congress (1885) – Phases of the National Movement – Legacies of the Freedom Struggle – Constitution Making Process – Constituent Assembly Debates – Goals, Objectives and Philosophy of the Indian Constitution.

UNIT III FEDERALISM, NATIONAL INTEGRATION AND NATION-BUILDING 9

Why a Federal System? – Features of Indian Federalism – Centre–State Relations – National Integration: Meaning, Need and Challenges – Nation-Building: Issues of Identity, Diversity and Unity – Challenges of Nation-Building – Rajni Kothari's "State Against Democracy" – Democracy, Pluralism and Integration.

UNIT IV SOCIAL MOVEMENTS AND POLITICAL TRANSFORMATION 9

New Social Movements – Women's Movements – Farmers' Movements – Dalit Movements – Environmental Movements – Human Rights Movements – Civil Society and People's Initiatives – Role of Social Mobilization in Nation-Building – Political Participation and Citizenship.

UNIT V CONTEMPORARY INDIAN POLITICAL SYSTEM AND FUTURE DIRECTIONS 9

The Changing Nature of the Indian Political System – Shifts in Party Systems – Electoral Behaviour – Governance Challenges – Role of Media and Public Opinion – Political Reforms – Future Scenario of Indian Democracy – What Can We Do? – Strengthening Participation, Accountability and Democratic Governance.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Explain the theoretical foundations of the State, its organs, and their functioning within the political system.
2. Describe the historical background, philosophy and evolution of the Indian political system and constitutional framework.
3. Analyse the major streams, issues and challenges related to national integration and nation-building in India.
4. Evaluate the functioning of India's political processes and governance mechanisms from an informed and critical perspective.
5. Propose constructive ways for effective citizen participation aimed at strengthening governance, democratic delivery systems, and societal well-being.

REFERENCES

1. Sunil Khilnani, The Idea of India. Penguin India Ltd., New Delhi.
2. Madhav Khosla, The Indian Constitution, Oxford University Press. New Delhi, 2012.
3. Brij Kishore Sharma, Introduction to the Indian Constitution, PHI, New Delhi, latest edition.
4. Sumantra Bose, Transforming India: Challenges to the World's Largest Democracy, Picador India, 2013.
5. Atul Kohli, Democracy and Discontent: India's Growing Crisis of Governability, Cambridge University Press, Cambridge, U. K., 1991.
6. M. P. Singh and Rekha Saxena, Indian Politics: Contemporary Issues and Concerns, PHI, New Delhi, 2008, latest edition.

7. Rajni Kothari, Rethinking Democracy, Orient Longman, New Delhi, 2005.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	2	-	3	2	2	2	2	-	3	3	-	-
CO2	2	2	-	2	-	2	2	2	1	2	-	3	3	-	-
CO3	2	3	-	3	-	3	3	2	2	2	-	3	3	2	2
CO4	2	3	2	3	-	3	3	2	2	3	-	3	3	2	2
CO5	2	2	2	3	-	3	3	2	3	3	2	3	3	3	3
Avg.	**3**	**3**	**1**	**3**	**-**	**3**	**3**	**3**	**3**	**3**	**1**	**3**	**3**	**2**	**2**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24MX3090 INDUSTRIAL SAFETY

L	T	P	C
3	**0**	**0**	**0**

COURSE OBJECTIVES

1. To Understand the Introduction and basic Terminologies safety.
2. To enable the students to learn about the Important Statutory Regulations and standards.
3. To enable students to Conduct and participate the various Safety activities in the Industry.
4. To have knowledge about Workplace Exposures and Hazards.
5. To assess the various Hazards and consequences through various Risk Assessment Techniques.

UNIT I SAFETY TERMINOLOGIES 9

Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators-Flammability- Toxicity Time-weighted Average (TWA) - Threshold Limit Value (TLV) - Short Term Exposure Limit (STEL)- Immediately dangerous to life or health (IDLH)- acute and chronic Effects- Routes of Chemical Entry-Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet MSDS

UNIT II STANDARDS AND REGULATIONS 9

Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S) - Occupational Safety and Health Audit IS14489:1998- Hazard Identification and Risk Analysis- code of practice IS 15656:2006

UNIT III SAFETY ACTIVITIES 9

Toolbox Talk- Role of safety Committee- Responsibilities of Safety Officers and Safety Representatives- Safety Training and Safety Incentives- Mock Drills- On-site Emergency Action Plan- Off-site Emergency Action Plan- Safety poster and Display- Human Error Assessment

UNIT IV WORKPLACE HEALTH AND SAFETY 9

Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA- Unsafe act & Unsafe Condition- Electrical Hazards- Crane Safety- Toxic gas Release

UNIT V HAZARD IDENTIFICATION TECHNIQUES 9

Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazard and Operability- Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative Risk Assessment- Checklist Analysis- Root cause analysis- What-If Analysis- and Hazard Identification and Risk Assessment

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Understand the basic concept of safety.
2. Obtain knowledge of Statutory Regulations and standards.
3. Know about the safety Activities of the Working Place.
4. Analyze on the impact of Occupational Exposures and their Remedies
5. Obtain knowledge of Risk Assessment Techniques.

TEXT BOOKS

1. R.K. Jain and Prof. Sunil S. Rao Industrial Safety, Health and Environment Management Systems KHANNA PUBLISHER
2. L. M. Deshmukh Industrial Safety Management: Hazard Identification and Risk Control McGraw-Hill Education

REFERENCES

1. Frank Lees (2012) 'Lees' Loss Prevention in Process Industries. Butterworth-Heinemann publications, UK, 4th Edition.
2. John Ridley & John Channing (2008) Safety at Work: Routledge, 7th Edition.
3. Dan Petersen (2003) Techniques of Safety Management: A System Approach.
4. Alan Waring.(1996). Safety management system: Chapman &Hall, England
5. Society of Safety Engineers, USA

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	3	2	2	3	3	1	3	3	3	3
CO2	2	3	2	2	1	3	2	3	3	2	1	3	3	3	3
CO3	2	2	2	2	1	2	2	2	3	2	1	2	3	3	3
CO4	3	3	3	2	2	3	2	2	3	2	1	3	3	3	3
CO5	3	2	3	2	2	3	2	2	3	2	2	3	3	3	3
Avg.	3	3	3	3	2	3	3	3	3	3	2	3	3	3	3

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

OPEN ELECTIVES

OPEN ELECTIVE I

24OEME01 FUNDAMENTALS OF AERONAUTICAL ENGINEERING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. To acquire the knowledge on the Historical evaluation of Airplanes
2. To learn the different component systems and functions
3. To know the concepts of basic properties and principles behind the flight
4. To learn the basics of different structures & construction
5. To learn the various types of power plants used in aircrafts

UNIT I HISTORY OF FLIGHT 8

Balloon flight-ornithopter-Early Airplanes by Wright Brothers, biplanes and monoplanes, Developments in aerodynamics, materials, structures and propulsion over the years.

UNIT II AIRCRAFT CONFIGURATIONS AND ITS CONTROLS 10

Different types of flight vehicles, classifications-Components of an airplane and their functions- Conventional control, powered control- Basic instruments for flying-Typical systems for control actuation.

UNIT III BASICS OF AERODYNAMICS 9

Physical Properties and structures of the Atmosphere, Temperature, pressure and altitude relationships, Newton's Law of Motions applied to Aeronautics-Evolution of lift, drag and moment. Aerofoils, Mach number, Maneuvers.

UNIT IV BASICS OF AIRCRAFT STRUCTURES 9

General types of construction, Monocoque, semi-monocoque and geodesic constructions, typical wing and fuselage structure. Metallic and non-metallic materials. Use of Aluminium alloy, titanium, stainless steel and composite materials. Stresses and strains-Hooke's law-stress-strain diagrams- elastic constants-Factor of Safety.

UNIT V BASICS OF PROPULSION 9

Basic ideas about piston, turboprop and jet engines – use of propeller and jets for thrust production- Comparative merits, Principle of operation of rocket, types of rocket and typical applications, Exploration into space.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Illustrate the history of aircraft & developments over the years.
2. Ability to identify the types & classifications of components and control systems.
3. Explain the basic concepts of flight & Physical properties of Atmosphere.
4. Identify the types of fuselage and constructions.
5. Distinguish the types of Engines and explain the principles of Rocket.

TEXT BOOKS

1. Anderson, J.D., Introduction to Flight, McGraw-Hill; 8th edition, 2015.
2. E Rathakrishnan, "Introduction to Aerospace Engineering: Basic Principles of Flight", John Wiley, NJ, 2021.
3. Stephen.A. Brandt, Introduction to aeronautics: A design perspective, 2nd edition, AIAA Education Series, 2004.

REFERENCES

1. Sadhu Singh, "Internal Combustion Engines and Gas Turbine"-, SS Kataraia & Sons, 2015.
2. Kermode, "Flight without Formulae", -, Pitman; 4th revised edition 1989.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	-	1	1	1	2	3	2	3	2
CO2	3	3	3	2	2	2	1	1	2	2	2	2	2	3	2
CO3	3	3	3	2	2	2	1	1	2	2	3	3	2	3	2
CO4	3	3	3	2	2	2	1	1	2	2	3	3	2	3	2
CO5	3	3	3	2	2	2	1	1	2	2	3	3	2	3	2
Avg.	**3**	**3**	**3**	**2**	**2**	**2**	**1**	**1**	**2**	**2**	**3**	**3**	**2**	**3**	**2**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24OEME02 **ENERGY TECHNOLOGY**

L	T	P	C
3	**0**	**0**	**3**

COURSE OBJECTIVES

1. To understand fundamental energy concepts, global/Indian resources, consumption patterns, and the importance of renewable energy prospects.
2. To evaluate the operation, efficiency, merits, and demerits of conventional power generation systems including thermal, hydro, and nuclear plants.
3. To learn about various non-conventional energy technologies such as solar, wind, ocean, tidal, and geothermal systems and their applications.

4. To explore biomass conversion methods, the principles of different fuel cells, magneto hydrodynamic power generation, and energy storage technologies.
5. To apply energy conservation principles and conduct energy audits in industrial settings, particularly within chemical process plants.

UNIT I INTRODUCTION 9

Units of energy, conversion factors, general classification of energy, world energy resources and energy consumption, Indian energy resources and energy consumption, energy crisis, energy alternatives, Renewable and non-renewable energy sources and their availability. Prospects of Renewable energy sources.

UNIT II CONVENTIONAL ENERGY 9

Conventional energy resources, Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants, efficiency, merits and demerits of the above power plants, combustion processes, fluidized bed combustion.

UNIT III NON-CONVENTIONAL ENERGY 9

Solar energy, solar thermal systems, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, solar energy application in India, energy plantations. Wind energy, types of windmills, types of wind rotors, Darrieus rotor and Gravian rotor, wind electric power generation, wind power in India, economics of wind farm, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy.

UNIT IV BIOMASS ENERGY 9

Biomass energy resources, thermo-chemical and biochemical methods of biomass conversion, combustion, gasification, pyrolysis, biogas production, ethanol, fuel cells, alkaline fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, solid polymer electrolyte fuel cell, magneto hydrodynamic power generation, energy storage routes like thermal energy storage, chemical, mechanical storage and electrical storage.

UNIT V ENERGY CONSERVATION 9

Energy conservation in chemical process plants, energy audit, energy saving in heat exchangers, distillation columns, dryers, ovens and furnaces and boilers, steam economy in chemical plants, energy conservation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

1. Describe the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels.
2. Excel as professionals in the various fields of energy engineering.

3. Compare different renewable energy technologies and choose the most appropriate based on local conditions.
4. Explain the technological basis for harnessing renewable energy sources.
5. Identify current developments and emerging trends within the field of renewable energy technologies

TEXT BOOKS

1. Rao, S. and Parulekar, B.B., Energy Technology, Khanna Publishers, 2005.
2. Rai, G.D., Non-conventional Energy Sources, Khanna Publishers, New Delhi,1984.
3. Bansal, N.K., Kleeman, M. and Meliss, M., Renewable Energy Sources and Conversion Technology, Tata McGraw Hill, 1990.
4. Nagpal, G.R., Power Plant Engineering, Khanna Publishers, 2008.

REFERENCES

1. Nejat Vezirog, Alternate Energy Sources, IT, McGraw Hill, New York.
2. El. Wakil, Power Plant Technology, Tata McGraw Hill, New York, 2002.
3. Sukhatme. S.P., Solar Enery - Thermal Collection and Storage, Tata McGraw hill, New Delhi, 1981.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	2	1	1	1	2	3	3	3	2
CO2	3	3	3	2	2	1	2	1	2	2	2	2	3	3	2
CO3	3	3	3	2	2	1	2	1	2	2	3	3	3	3	2
CO4	3	3	3	2	2	1	2	1	2	2	3	3	3	3	2
CO5	3	3	3	2	2	1	2	1	2	2	3	3	3	3	2
Avg.	**3**	**3**	**3**	**2**	**2**	**1**	**2**	**1**	**2**	**2**	**3**	**3**	**3**	**3**	**2**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

OPEN ELECTIVE – II

24OEME03 ENVIRONMENTAL ENGINEERING AND POLLUTION CONTROL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. To impart knowledge on the atmosphere and its present condition, global warming and eco-legislations.
2. To detail on the sources of air, water and noise pollution and possible solutions for mitigating their degradation.
3. To elaborate on the technologies available for generating energy from waste.
4. To study the solid and hazardous waste generation, characteristics, management strategies, disposal methods, and waste minimization.
5. To analyze various industrial pollution types, their impacts, control methods, and perform basic environmental impact assessments.

UNIT I INTRODUCTION 9

Global atmospheric change – greenhouse effect – Ozone depletion - natural cycles - mass and energy transfer – material balance – environmental chemistry and biology – impacts – environmental.

UNIT II AIR POLLUTION 9

Pollutants - sources and effect – air pollution meteorology – atmospheric dispersion – indoor air quality - control methods and equipment's - issues in air pollution control – air sampling and measurement.

UNIT III WATER POLLUTION 9

Water resources - water pollutants - characteristics – quality - water treatment systems – waste water treatment - treatment, utilization and disposal of sludge - monitoring compliance with standards.

UNIT IV WASTE MANAGEMENT 9

Sources and Classification – Solid waste – Hazardous waste - Characteristics – Collection and Transportation - Disposal – Processing and Energy Recovery – Waste minimization.

UNIT V OTHER TYPES OF POLLUTION FROM INDUSTRIES 9

Noise pollution and its impact - oil pollution - pesticides - instrumentation for pollution control - water pollution from tanneries and other industries and their control – environment impact assessment for various projects – case studies. Radiation pollution: types, sources, effects, control of radiation pollution.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Explain global environmental issues, natural cycles, and fundamental principles of environmental chemistry and biology.
2. Identify major air pollutants, analyze their effects, and apply suitable air pollution control and monitoring techniques.
3. Assess water quality, evaluate water and wastewater treatment processes, and ensure compliance with environmental standards.
4. Classify and manage solid and hazardous wastes using appropriate collection, processing, disposal, and minimization methods.
5. Evaluate various industrial pollution types, recommend control measures, and perform basic environmental impact assessments.

TEXT BOOKS

1. Arcadio P Sincero and G.A. Sincero, Environmental Engineering – A Design Apporach, Prentice Hall of India Pvt Ltd, New Delhi, 2002.
2. Bishop P., Pollution Prevention: Fundamentals and Practice, McGraw-Hill International Edition, McGraw-Hill book Co, Singapore, 2000.

REFERENCES

1. G.Masters, Introduction to Environmental Engineering and Science Prentice Hall of India Pvt Ltd, New Delhi, 2003.
2. Gilbert M. Masters, Introduction to Environmental Engineering and Science, 2nd Edition, Prentice Hall, 1998.
3. H.Ludwig, W.Evans, Manual of Environmental Technology in Developing Countries, International Book Company, Absecon Highlands N.J. (1991).
4. H.S.Peavy, D.R.Rowe and G.Tchobanoglous, Environmental Engineering McGraw-Hill Book Company, NewYork, (1985).
5. Rao C.S., Environmental Pollution Control Engineering, 2nd Edition, New Age International Publishers, 2006.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	2	1	1	1	2	3	2	3	2
CO2	3	3	3	2	2	1	2	1	2	2	2	2	2	3	2
CO3	3	3	3	2	2	1	2	1	2	2	3	3	2	3	2
CO4	3	3	3	2	2	1	2	1	2	2	3	3	2	3	2
CO5	3	3	3	2	2	1	2	1	2	2	3	3	2	3	2
Avg.	**3**	**3**	**3**	**2**	**2**	**1**	**2**	**1**	**2**	**2**	**3**	**3**	**2**	**3**	**2**

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Note: The average value of this course to be used for program articulation matrix.

24OEME04 ELEMENTS OF MARINE ENGINEERING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students

1. To understand the role of Marine machinery systems.
2. To be familiar with Marine propulsion machinery system.
3. To acquaint with Marine Auxiliary machinery system.
4. To have acquired basics of Marine Auxiliary boiler system.
5. To be aware of ship propellers and steering system.

UNIT I ELEMENTARY KNOWLEDGE ON MARINE MACHINERY SYSTEMS 9

Marine Engineering Terminologies, Parts of Ship, Introduction to Machinery systems on board ships –Propulsion Machinery system, Electricity Generator system, Steering gear system, Air compressors & Air reservoirs, Fuel oil and Lubricating Oil Purifiers, Marine Boiler systems.

UNIT II MARINE PROPULSION MACHINERY SYSTEM 9

Two stroke Large Marine slow speed Diesel Engine – General Construction, Basic knowledge of Air starting and reversing mechanism, Cylinder lubrication oil system, Main lubricating oil system and cooling water system.

UNIT III MARINE AUXILIARY MACHINERY SYSTEM 9

Four stroke medium speed Diesel engine – General Construction, Inline, V-type arrangement of engine, Difference between slow speed and medium speed engines – advantages, limitations and applications.

UNIT IV MARINE BOILER SYSTEM 9

Types of Boilers – Difference between Water tube boiler and Fire tube boiler, Need for boiler on board ships, Uses of steam, Advantages of using steam as working medium, Boiler mountings and accessories – importance of mountings, need for accessories.

UNIT V SHIP PROPELLERS AND STEERING MECHANISM 9

Importance of Propellor and Steering gear, Types of propellers - Fixed pitch propellers, Controllable pitch propellers, Water jet propellers, Steering gear systems - 2-Ram and 4 Ram steering gear, Electric steering gear.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Distinguish the role of various marine machinery systems.
2. Relate the components of marine propulsion machinery system.
3. Explain the importance of marine auxiliary machinery system.
4. Acquire knowledge of marine boiler system.
5. Understand the importance of ship propellors and steering system.

TEXT BOOKS

1. Taylor, "Introduction to Marine engineering", Revised Second Edition, Butterworth Heinemann, London, 2011.
2. J.K.Dhar, "Basic Marine Engineering", Tenth Edition, G-Maritime Publications, Mumbai, 2011.
3. K.Ramaraj, "Text book on Marine Engineering", Eswar Press, Chennai, 2018.

REFERENCES

1. Alan L.Rowen, "Introduction to Practical Marine Engineering, Volume 1&2, The Institute of Marine
   Engineers (India), Mumbai, 2006.
2. A.S.Tambwekar, "Naval Architecture and Ship Construction", The Institute of Marine Engineers (India), Mumbai, 2015.
3. Sukhatme. S.P., Solar Energy - Thermal Collection and Storage, Tata McGraw hill, New Delhi, 1981.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	2	1	1	1	2	3	1	2	2
CO2	3	3	3	2	2	1	2	1	2	2	2	2	1	2	2
CO3	3	3	3	2	2	1	2	1	2	2	3	3	1	2	2
CO4	3	3	3	2	2	1	2	1	2	2	3	3	1	2	2
CO5	3	3	3	2	2	1	2	1	2	2	3	3	1	2	2
Avg.	**3**	**3**	**3**	**2**	**2**	**1**	**2**	**1**	**2**	**2**	**3**	**3**	**1**	**2**	**2**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

OPEN ELECTIVE – III

24OEME05 ALTERNATIVE FUELS AND ENERGY SYSTEMS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. To acquire knowledge on availability of possible alternate fuels and their properties to use as fuel in CI and SI engines.
2. To learn the properties, processing methods, and engine performance characteristics of vegetable oils as fuels.
3. To explain the production, properties, challenges, storage, and engine applications of hydrogen and LPG.
4. To study the production, purification, and combustion behaviour of biogas and natural gas in internal combustion engines.
5. To develop understanding of electric, hybrid, and fuel cell vehicle technologies, their components, configurations, and operational advantages.

UNIT I ALCOHOL FUELS 9

Introduction to alternative fuels. - Need for alternative fuels - Availability of different alternative fuels for SI and CI engines. Alcohols as fuels. Production methods of alcohols. Properties of alcohols as fuels. Methods of using alcohols in CI and SI engines. Blending, dual fuel operation, surface ignition and oxygenated additives. Performance combustion and emission characteristics in CI and SI engines. DME-DEE-as fuels.

UNIT II VEGETABLE OILS 9

Various vegetable oils and their important properties. Different methods of using vegetable oils engines – Blending, preheating Transesterification - emulsification - Performance – Combustion -Emission Characteristics in diesel engines.

UNIT III HYDROGEN AND LPG 9

Production methods of hydrogen- properties of hydrogen- Problems associated with hydrogen as fuel -solutions. Different methods of using hydrogen in SI and CI engines- Performance - combustion -emission Characteristics in SI and CI engines. Hydrogen storage – safety aspects of hydrogen. LPG-properties of LPG-Performance-combustion -emission Characteristics in SI and CI engines.

UNIT IV BIOGAS AND NATURAL GAS 9

Production methods of Biogas and Natural gas- Properties. Scrubbing of CO_2 and H_2S from Biogas. Modification required to use in SI and CI Engines – Performance-combustion - emission characteristics of Biogas and Natural gas in SI and CI engines.

UNIT V ELECTRIC, HYBRID AND FUEL CELL VEHICLES 9

Layout of Electric vehicle and Hybrid vehicles – Advantages and drawbacks of electric and hybrid vehicles. System components and drives- Electronic control system – Different configurations of Hybrid vehicles. Power split device. High energy and power density batteries – Basics of Fuel cell vehicles.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Acquire knowledge on possible alternate fuels and their properties to use as fuel in CI and SI engines.
2. Develop knowledge in all the possible ways of using alcohols as a fuel in IC engines.
3. List the challenges and difficulties in using alternative fuel in internal combustion engines.
4. Identify the uses of hydrogen as fuel in IC engines as an alternative for fossil fuels.
5. Understand the usefulness of natural acquiring gases towards IC engines.

TEXT BOOKS

1. Ayhan Demirbas, 'Biodiesel A Realistic Fuel Alternative for Diesel Engines', Springer-Verlag London Limited 2008, ISBN – 13:9781846289941.

REFERENCES

1. Dr. G. Devaradjane, Dr. M. Kumaresan, "Automobile Engineering" {, AMK Publishers, 2013.
2. Gerhard Knothe, Jon Van Gerpen, Jargon Krahl, The Biodiesel Handbook, AOCS Press Champaign, Illinois 2005.
3. Richard L Bechtold P. E., Alternative Fuels Guide book, Society of Automotive Engineers, 1997 ISBN 0-76-80-0052-1.
4. Science direct journals (Biomass& Bio energy, Fues, Energy, Energy conversion Management, Hydrogen Energy, etc.) on biofuels.
5. Transactions of SAE on Biofuels (Alcohols, vegetable oils, CNG, LPG, Hydrogen, Biogas etc.).

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	2	1	1	1	2	3	2	3	3
CO2	3	3	3	2	2	1	2	1	2	2	2	3	2	3	3
CO3	3	3	3	2	2	1	2	1	2	2	3	3	2	3	3
CO4	3	3	3	2	2	1	2	1	2	2	3	3	2	3	3
CO5	3	3	3	2	2	1	2	1	2	2	3	3	2	3	3
Avg.	**3**	**3**	**3**	**2**	**2**	**1**	**2**	**1**	**2**	**2**	**3**	**3**	**2**	**3**	**3**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.

24OEME06 **FOUNDATION OF ROBOTICS**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. To study the kinematics, drive systems and programming of robots.
2. To study the basics of robot laws and transmission systems.
3. To familiarize students with the concepts and techniques of robot manipulator, its kinematics.
4. To familiarize students with the various Programming and Machine Vision application in robots.
5. To build confidence among students to evaluate, choose and incorporate robots in engineering systems.

UNIT I FUNDAMENTALS OF ROBOT 9

Robot – Definition – Robot Anatomy – Co-ordinate systems, Work Envelope, types and classification – specifications – Pitch, yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and their functions – Need for Robots – Different Applications.

UNIT II ROBOT KINEMATICS 9

Forward kinematics, inverse kinematics and the difference: forward kinematics and inverse Kinematics of Manipulators with two, three degrees of freedom (in 2 dimensional) – derivations and problems. Homogeneous transformation matrices, translation and rotation matrices.

UNIT III ROBOT DRIVE SYSTEMS AND END EFFECTORS 9

Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of all these drives. End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic grippers, vacuum grippers, internal grippers and external grippers, selection and design considerations of a gripper.

UNIT IV SENSORS IN ROBOTICS 9

Force sensors, touch and tactile sensors, proximity sensors, non-contact sensors, safety considerations in robotic cell, proximity sensors, fail safe hazard sensor systems, and compliance mechanism. Machine vision system - camera, frame grabber, sensing and digitizing image data – signal conversion, image storage, lighting techniques, image processing and analysis.

UNIT V PROGRAMMING AND APPLICATIONS OF ROBOT 9

Teach pendant programming, lead through programming, robot programming languages – VAL programming – Motion Commands, Sensors commands, End-Effector Commands, and simple programs - Role of robots in inspection, assembly, material handling, underwater, space and medical fields.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Interpret the features of robots and technology involved in the control.
2. Apply the basic engineering knowledge and laws for the design of robotics.
3. Explain the basic concepts like various configurations, classification and parts of end effectors compare various end effectors and grippers and tools and sensors used in robots.
4. Explain the concept of kinematics, degeneracy, dexterity and trajectory planning
5. Demonstrate the image processing and image analysis techniques by machine vision system.

TEXT BOOKS

1. Ganesh. S. Hedge, "A textbook of Industrial Robotics", Lakshmi Publications, 2006.
2. Mikell. P. Groover, "Industrial Robotics – Technology, Programming and applications" McGraw Hill 2ND edition 2012.

REFERENCES

1. Fu K.S. Gonalz R.C. and ice C.S.G. "Robotics Control, Sensing, Vision and Intelligence", McGraw Hill book co. 2007.
2. Yoram Koren, "Robotics for Engineers", McGraw Hill Book, Co., 2002.
3. Janakiraman P.A., "Robotics and Image Processing", Tata McGraw Hill 2005.
4. John. J. Craig, "Introduction to Robotics: Mechanics and Control" 2nd Edition, 2002.
5. Jazar, "Theory of Applied Robotics: Kinematics, Dynamics and Control", Springer India reprint, 2010.

CO-POs & PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	1	1	1	1	2	2	3	2	3
CO2	3	3	3	2	2	-	1	1	2	2	2	2	3	2	3
CO3	3	3	3	2	2	1	1	1	2	2	3	2	3	2	3
CO4	3	3	3	2	2	1	1	1	2	2	3	2	3	2	3
CO5	3	3	3	2	2	-	1	1	2	2	3	2	3	2	3
Avg.	**3**	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**3**	**2**	**3**	**2**	**3**

"1" - low, "2" - medium, "3" - high, "-" - no correlation

Note: The average value of this course to be used for program articulation matrix.